A Study on Detection of Diabetic Retinopathy Using Image Processing

Sandhya M.P#1, Uma Shenoy*2, Nausheda B.S@3
Dept of MCA, AIMIT, Beeri, Mangaluru, India,
#sandhyanambiar21@gmail.com,*humashenoy1@gmail.com

Abstract - One of the serious eye diseases that causes blindness is Diabetic Retinopathy. It has become one of the serious health threats both in India and across the world. This is a disease caused due to leakage of blood vessels of the retina, which causes blindness and vision loss. The complication of the diabetes associated to retina of the ocular perceiver is diabetic retinopathy. Periodic screening of the ocular perceiver has to undergo by a patient who has such diseases. Diabetes over a long time can cause leakage of micro vascular structures and also blockage within the retinal blood vessel. This paper deals with the various methods and techniques used for detecting diabetic retinopathy. It deals with Current challenges, Issues and trends in Diabetic Retinopathy detection.

Keywords – Diabetic Retinopathy, Blood Vessels, Microaneurysms, Hemorrhages, Image Processing

I. INTRODUCTION

Diabetic retinopathy is a medical condition which effects the eye (disorders in which there are high blood sugar levels). It is a leading cause of blindness. Upto eighty percent of those who are affected by Diabetic Retinopathy are those who had more than twenty years of diabetes. Most of the cases could be reduced with felicitous treatment and monitoring on a regular basis. Diabetic retinopathy can be found in those who has been suffering with diabetes over a long time. The main four stages of Diabetic Retinopathy is:

i) [Figure i] Mild Non-Proliferative Retinopathy- This is usually the early stage where micro-aneurysms may occur. These manifestations of the disease are diminutive areas of balloon-like swelling in the retinas diminutive blood vessels Right around 40% of individuals with diabetes are found to have mellow denotements of DR.

ii) [Figure ii] Moderate Non-Proliferative Retinopathy- As the disease advances, some veins that nourishment the retina are blocked. Cotton wool spots and constrained amount of venous bleeding can be optically discerned. Normally 16% of patients with moderate NPDR develops PDR within a year.

iii)[Figure iii] Rigorous Non-Proliferative Retinopathy – In this stage of diabetic retinopathy most of the blood vessels are blocked and many parts of the retina get denied with the blood supply. These regions of the retina send signs to the body to develop nascent veins for pabulum.

iv) [Figure iv] Proliferative Retinopathy- The most Advanced stage of Diabetic retinopathy where the signals send by retina for alimentation trigger magnification of incipient blood vessels. These blood vessels are anomalous and frangible. The blood vessels do not cause symptoms or vision loss by themselves. But they have thin and fragile walls. And leaking of blood could mean rigorous loss of vision and also serious impairment of vision. Its reported that about three% of people in this condition may suffer constricting loss of vision. (which avails in visually perceiving the details of the vision very limpidly)

People in developing and under developed countries mostly become the victims of DR due to
the lack of treatment and the required resources. Features like Blood vessels, exudes, hemorrhages, Microaneurysms, and textures are used for detection of DR. These affected features grow to the maximum and destroy the capillaries by leaking blood in retina. Image processing techniques used for the detection of Diabetic Retinopathy (DR) are displayed in this paper. Also Lesion detection techniques and Image Processing methods used for DR along with appropriate results are presented here.

II. LITERATURE SURVEY

Diabetic retinopathy (DR) happens when diabetes influences the circulatory blood arrangement of eye retina and harms the veins in the retina which prompts incomplete or complete visual deficiency.

In order to diagnose the diabetic retinopathy Bayesian detection Algorithm is used in classifying changes in retinal fundus images. This method detects the variation in brightness, the fundus image artifacts, outliers and also segmentation errors.

Segmentations of blood vessels, fovea and optical disk are also performed to detect variations of the fundus image. This algorithm can detect lesions Microaneurysm, Exudates, and Cotton wool spots successfully. But a drawback is that this algorithm fails to analyse vascular or the blood vessel shaped changes in fundus images. Instead, a new hybrid vessel segmentation algorithm is used which has morphological edge detector with Top Hat segmentation technique used in diagnosing Diabetic Retinopathy. Images from Drive database are used to test the algorithm which has 20 colour images. A True Positive Fraction of 0.8214 and False Positive Fraction of 0.0941 is achieved by the algorithm. This algorithm however cannot detect small image region vessels. The Colour retinal images are segmented by taking away the background and noise from image. The noisy region of the image consume a lot of processing time. That is why the RGB retinal images are transformed to hue, saturation, intensity (HSI) to perform the noise segmentation. After that, Morphological operations is used to remove the single pixel noise. Two retinal image databases, Diaretdb0 and Diaretdb1 with 219 retinal images, are used to test the proposed algorithm. In which .92% images are segmented accurately. 2-D Gabor wavelet is another vessel segmentation based technique upgrades the retinal fundus image. After the picture improvement is done the unsharp channel is utilized to expel the obscured impact from the upgraded picture to hone the vascular edges. From that point forward, Morphological Dilation administrator with watchful edge indicator gets the last Vessel division cover. This Technique is tried on DRIVE database with a normal precision of 0.9469 and standard deviation of 0.0053. Another methods used to segment exudates are K-means Clustering and colour space features. Pixel colour list data structure enables faster clustering. In the first step, the unnecessary fundus mask are removed by applying thresholding, after which color transformation constructs two space features namely, f1 and f2. The results of clustering confirms that the exudates are bright lesions and there colour is yellow. This method is evaluated using the dataset DIARETDB1 and a sensitivity of 71.96% along with PPV of 87% is found. Bright lesions mean exudates and the dark lesions mean Hemorrhages with Microaneurysms are detected on the basis of their intensity values.130 images from DIARETDB0 dataset are taken with their masks. Using Morphological techniques the blood vessels are extracted. At that point the Morphological Closed and Open operations are utilized to recognize the exudates and the optic disc. At long last the green channel is utilized to recognize HAM. A sensitivity of 93.1% and specificity of 80.7% is accomplished. With the end goal to fragment the Optic Disk from retinal picture, Morphological and Circular Hough Transform systems proposes another format based strategy. The results are evaluated from MESSIDOR database. Applying the algorithm on the database containing 1200 images, overlapping is found to be 0.92 compared to the elliptical and deformable models. Its inability to generate performance results better than Elliptical approach is its main drawback.

Knowledge based rough segmentation algorithm with unsupervised algorithm recognize retinal vessels in eye fundus image. To segment large vessels Ensemble learning based segmentation is used after the curve fitting technique detects the thin vessels. To evaluate the results DRIVE database is used, where a specificity of 0.9363 and sensitivity of 0.8854 is achieved. Adaptive thresholding is yet another technique based on pure splitting technique to detect exudates in retinal images. Coarse segmentation finds the local variations of image pixels by clearing border of image candidates. Morphological operations refines the results of Coarse segmentation. DIARETDB1 is used to evaluate the results. A Sensitivity of 91.2 with specificity of 99.3 is found. Gradient Vector Flow which is based on segmentation method segments the optic disc in retinal fundus image. Mean shift term improves the accuracy of GVF algorithm. Using DRIVE database to obtain results. Experimental results shows that this methodology outperforms the classical GVF and level set segmentation in terms of segmentation accuracy.

Lin Lin uses the threshold based image segmentation, inscribed parallelogram, and ellipse equation to estimate pupil centre and radius which identifies the diabetic retinopathy. Flux mechanism and Graph cut methods. Adaptive Histogram Equalization and Pruning improves the veins in the simple initial step. Here, DRIVE and STARE databases are utilized. 89.51% of True Positive Rate on STARE and 77.6% on DRIVE is acquired. 2-D
Gradient Filter with Intensity Adjustment enhancement technique distinguishes the section exudates with the end goal to analyze diabetic retinopathy and retinoblastoma. It was found after a statistical analysis, the mean to be 0.0388 & std dev to be 0.1877 for retinoblastoma and mean of 0.0388 & std dev of 0.1790 for exudative maculopathy. Median filters are used to increase the visual contrast in pre-processing step. Next, Morphological technique is made use to detect Red lesions. The morphological closed operation detects the blood vessels. Finally the Rule based Classifier classifies the red lesion candidates. DIARETDB1 database provides with a sensitivity of 98% and specificity of 86%. The only drawback being this method fails in detecting red lesions inside fovea during refining process.

Gaussian filter is used to detect Blood vessels while density analysis is performed on Hemorrhage candidates and the classification is performed at the end. Normal cases are seen to be 90% accurate where NDPR were 87.5% correct. K.Narasimhan proposed 2 algorithms consisting of filtering operations which are morphological transformation and region growing methods for detecting lesions. An Accuracy of 95% is acquired with DIARETDB1 database and 92% for a hospital database. Bayesian Network with support vector machine classifies images. 95% Classification rate for SVM and 90% in Bayyesian is obtained.

M. Usman Akram has used 2 dimensional Gabor Wavelet with multi layered thresholding technique to propose a method for vessel segmentation for detecting neovascularization which is a sign of Proliferative diabetic retinopathy. Gabor Wavelet is mainly used for Vessel enhancement after the multi-layered thresholding creates a binary mask for vessel segmentation. DRIVE and STARE databases are used here. 95% average Accuracy ad 0.03 Std deviation is found. A survey by Parist Jitpakdee presented Hemorrhage detection in diagnosis of diabetic retinopathy from the retinal images. The work reviews on the latest work on common methods for detecting hemorrhages that is, Morphological processing, Neural Network, Classification, Region Growing, and Inverse method. The Comparison of the methods which are available are done on the basis of Image, Lesion and Pixel based.

It is found that Image based and Lesion based gives high sensitivity but low specificity. Extraordinary Learning Machine approach is utilized in proposing another strategy for vein location in retinal pictures. The pixel classification output is provided to the ELM. The grey level and fixed moment features representing pixels are calculated by it. DRIVE and STARE databases are used here. 90% Accuracy is obtained. Feature Extraction method is used in diagnosing diabetic retinopathy. Adaptive histogram approach extracts features. Binary thresholding followed by morphological operation is used in removing small and not relevant objects from the image. Boundary tracing technique is used for detecting the optical disc boundary. DRIVE and DIARETDB1 databases are used on the basis of area, and centroid of Optic Disc.

III. CONCLUSIONS

The retinal blood vessels are damaged due to fluid leakage in vessels in diabetic retinopathy. The various lesions like Exudes, hemorrhages, microaneurysms and textures helps in detecting the stages of Diabetic Retinopathy. It is found that diagnosing diabetic retinopathy on time or as early as possible can reduce the chances of loss of vision upto 50%.

The Image Processing strategies examined in this paper can identify the illness precisely. From the study it is found that Hybrid methodology must be used more to detect Diabetic Retinopathy accurately because it provides better specificity and sensitivity compared to other techniques. Hybrid Technology is found to be accurate and efficient.

REFERENCES