Diabetic Retinopathy using Image Processing – A Survey

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Abstract— Diabetes mellitus which is commonly known as diabetes, is a metabolic disease that causes high blood sugar in the body. Diabetic retinopathy which is also known as diabetic eye disease, is a medical condition in which damage occurs to the retina due to diabetes mellitus. It is a leading cause of blindness. Diabetic retinopathy is caused by prolonged high blood glucose level overtime, high sugar glucose levels might weaken and damage the small blood vessels within the retina. This may also cause haemorrhages, exudates and even swelling of the retina. At early stage there will no signs of diabetic retinopathy. In this paper, we have done a survey on detection and classification of different stages of diabetic retinopathy. Detection of diabetic retinopathy at early stage might prevent vision loss.

Keywords: Diabetic Retinopathy, Image Processing

I. INTRODUCTION

Diabetes is a disease, that occurs when the blood glucose, also called blood sugar, is very high. With the diabetes, the body neither can make enough insulin nor can effectively use the insulin. Diabetic retinopathy is a medical condition that cause damage to the retina which is caused by complications of diabetes mellitus. The condition can lead to blindness if it is left untreated. There are four Types of diabetic retinopathy.1.Mild non-proliferative diabetic retinopathy (NPDR) 2.Moderate NPDR 3.Severe NPDR 4.Proliferative diabetic retinopathy (PDR). In Mild non-proliferative diabetic retinopathy stage(NPDR) small areas of balloon-like swelling called microaneurysms — form in the retinal blood vessels and it may leak the fluid into the retina. In Moderate NPDR, as the disease progresses, blood vessels that provide important nourishment to the retina may cause swelling and lose their ability to transport blood. In severe NPDR, the blood supply to the retina is disrupted, which leads to more damage in the blood vessels. In Proliferative diabetic retinopathy (PDR), which is the advanced stage of DR, the retina secretes growth factors in order to generate new blood vessels. The new blood vessels grow along with the inside the surface of the retina as well as in the vitreous gel, it appears like jelly fluid that fills the center of the eye.

II. RELATED WORK

It provides an approach to automate the identification of the presence of diabetic retinopathy from the colour fundus images of retina. The input fundus image is classified into three classe normal, non-proliferative, proliferative diabetic retinopathy. To identify the stages, blood vessel segmentation from input image is achieved by gaussian filtering. An input driven method is used for the generation of mask and local entropy is used to accomplish the thresholding. The training results using artificial neural networks (ANN) is 67.2% and using svm is 68%. [1]

The automated method for classification of diabetic retinopathy has three stages namely first is image processing, feature extraction and image classification. Retinopathy is classified into two types: Non-proliferative and proliferative. The processing techniques used are canny edge detector and histogram equalization method. Canny edge detector technique is used to detect the edge pixels. Histogram equalization is a non-parametric method to match cumulative distribution function of given image to the reference image. The results show that it gives accuracy of 68.7%. [2]

The primary goal to identify the patients having diabetic retinopathy using colour fundus image. In CNN the network contains an image where each and every feature is mapped to in the Re LU layer. The final feature obtained is flattened and unrolled into a single feature vector. In ANN the single feature is taken as input and it consists of a hidden layer containing 128 nodes to which the feature vector is forward propagated from the input layer by ReLU Activation. The output layer consists of hidden layer which contains value greater than 0 and less than 1. If the value is greater than 0.5 then it is treated as healthy otherwise, it is diabetes. A Training Accuracy of 91.67 % and validation accuracy of 100% are obtained. The CNN obtains more accuracy. Training the model can be done only if the dataset is small. [3]

The main objective is to classify different stages of diabetic retinopathy. At first the fundus images were pre-processed. Then the extracted exudate were used to detect the anomaly stages of NPDR. Finally the extracted features were converted into the region based statistical data using statistical model and the output values were sent as input to ANN. 85% of accuracy was found but it did not provide an proper reason for automated DR anomaly classification. Due to the drawbacks in ANN model, Multi agent solution (MAS) for diabetic retinopathy classification might be suitable for complex scenarios such as biomedical applications. Accuracy of 85% is obtained. It did not provide an proper reason for automated DR anomaly classification. [4]

The classification of diabetic retinopathy using Fundus Image. Firstly the image undergoes image pre-processin which increases reliability and efficiency of the image. In order to detect blood vessels, haemorrhages the images undergo grey scakle conversion process. It undergoes green channel process for the detection of exudates. SVM is used to calculate data clustering and also for recognition of patterns. It is used for classification. The accuracy obtained was 92.6%.[5]

To help the people in detecting the diabetic retinopathy in advance and from losing their vision. this Automatically classify the grade of the non-proliferative diabetic retinopathy at any retinal image. Extracted features: to detect the NDPR automatically we have implemented three process to extract some features. They are 1) Blood vessels:the reason of this process is used to determine the density of blood vessel in the retinal image. RGB image is transformed to its CMY components and isolated magenta component. 2) Microaneurysms: these are small lumps in blood vessel.to determine no of microaneurysm, we extracted

the green component. 3) Hard exudates: from the CMY image magenta component is extracted to determine the hard exudates before computing the density of hard exudates the erosion is executed.[6]

Diabetic retinopathy is a eye disease that effects the retina, the main objective is to detect retinal micro-aneurysms and exudates for automatic screening of diabetic retinopathy. Pre-processing are applied then morphological operations performed to identify exudates and micro-aneurysms. Finally by applying SVM and KNN classifier which gives the grade of abnormality. It directly shows the disease grade as normal, moderate, severe. Early detection and diagnosis of diabetic retinopathy help the patients from the vision loss and also the severity of disease can be decreases. [7]

The objective of this is to identify the phases of diabetic retinopathy to avoid causing of blindness it also helps in identifying haemorrhages and also to detect blood vessels. The approach uses the detection of blood vessels and haemorrhages that are detected in retinal images. The detection uses density analysis and bounding box. The retinal segmentation uses the difference between the vessels of the blood and its surrounding. The accuracy of the system is 74%. [8]

The approach is to detect the retinal lesions such as exudates, microaneurysms and haemorrhages. The severity is identified by the count size and locations to avoid future intervension. The presence of exudates depicts severity. The identification of microaneurysms and hemorrhages is by blood vessel and fovea region have to be subtracted from the retinal image before diagnosing. The retinal grading algorithm is used . based on this patient is treated accordingly. [9]

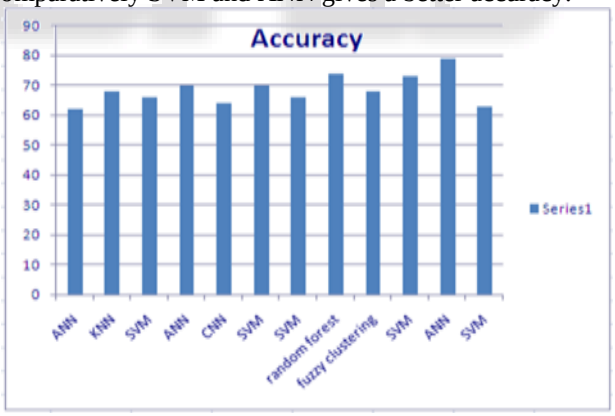
one of the diabetic symptom is existence of hard exudates, hard exudates in retinal fundus image are employed to classify the moderate and severe NDPR , this achive the accuracy of 90.5%, classification of diabetic retinopathy performed in order to determine the degree of disease severity, there are mainly three stages first one is exudates segmentation in this process segments exudates in a color fundus image ,retinal fundus image is input for this process from the dataset , ouput has better contrast then input image.and next one is feature extraction the main goal is to find the feature most relevant exudates in retinal fundus image. Last one is classification of severity here we use 147 images which labelled with retinopathy grades, the dataset is divided into testing set and training set, for SVM model training set is used and testing set is used in model validation. Which gives the accuracy of 73%.[10]

This paper presents the classification of Diabetic Retinopathy using textual features. The Detection of and segmentation of abnormal regions in retina is a difficult task.The proposed work is to extract the textual feature from the retinal region including the defective portions from blood vessels and optic disc are excluded, whose features may give inconsistent features but may not effect the classification result. The extracted text features vary with normal retinal region. These features are analysed to identify the effective classification of DR. In the proposed system, the retinal CFI is taken as input and it is processed to classify normal or diabetic retinopathy classes. Preprocessing involves Adaptive Histogram Equalization and Segmentation of Blood Vessels. In order to classify the image as DR or normal class, Haralick GLCM features are used. The SVM methos is used to classify whether the extracted texture feature are DR or normal. GLCM feaures obtained an accuracy of 87% and SVM obtained an accuracy of 79% with ANN.[11]

Our main aim is to detect the early stage of Daibetic retinopathy such as micro aneurysm using feature extracted from preprocessed image, here we use pre-processing steps like padding ,median filtering, histogram equalization, image segmentation and candy edge filter. Image Acquication. Pre-Processing stage segmentation Stage, Disease Classification / Abnormalities Identification these are methods we use here. NPRTOOL classifies the image as presence or absence of micro-aneurysm.[12]

III. COMPARATIVE WORK

According to the survey which we have done, we can detect and classify diabetic retinopathy with the help of SVM, ANN, CNN, KNN, Fuzzy C clustering algorithms. Comparatively SVM and ANN gives a better accuracy.



Sl No	Parameter	Paper[1]	Paper[2]	Paper[3]	Paper[4]	Paper[5]	Paper[6]	Paper[7]
1	Diagnosis	NPDR and PDR	NPDR and PDR	NPDR and PDR	NPDR and PDR	NPDR and PDR	NPDR ,moderate and PDR	NPDR and PDR
2	Classification Algorithm	ANN SVM	KNN	CNN	ANN	SVM	SVM	SVM,KNN
3	Processing Parameters	Blood Vessel Segmentat Ion	Edges	Blood Vessels ,excudates and Haemorrhages	Microaneurysms Exudates	Greyscale Image	Blood Vessel, Microac Neurysm	Microaneurysms, Exudates
4	Image processing Algorithm	Adaptive Mask Generation	Histogram Equalizat Ion	Grey scale conversion, gradient	Multi layer perceptron	Grey scale conversion,	Large Segmen Tation	Edge dete Ction

		Blood vessel segment Ion by Gaussian filtering		magnitude segmentation				
5	Accuracy	ANN-62.2% SVm-68.1%	KNN-68.7%	CNN-91.67%	ANN-85%	SVM-92.6%	SVM=70%	SVM-66%

Sl No	Parameter	Paper[8]	Paper[9]	Paper[10]	Paper[11]	Paper[12]
1	Diagnosis	NPDR and PDR	NPDR and PDR	NDPR and PDR	NPDR and PDR	NPDR and PDR
2	Classification Algorithm	Random Forest	Fuzzy clustering	SVM	SVM, ANN	SVM and navie bayes
3	Processing Parameters	Blood Vessel Segmentation and hemorrhages	Exaduates	Exudates segmentation, feature extraction,classification of severity	Hard exudates, Hemorrhages, Micro aneurysms, Soft exudates	Micro-anuerysms
4	Image processing Algorithm	Density analysis and bounding box technique	Retinal grading algorithm	Morphological method	Histogram equalization, Morphological operations, GLCM extraction	Zero padding, histogram equalization, segmentation and canny edge
5	Accuracy	Random forest – 74%	Fuzzy clustering-68%	SVM-73%	SVM-87% ANN-79%	SVM-63.3% Naïve-bayes-60%

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