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Diabetic retinopathy detection and classification techniques

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Abstract

Objectives: The main objective of this research is to find out the diabetic retinopathy from retinal image with better accuracy.
Methods: The analysis has been done by various methods to provide the efficient diabetic retinopathy detection results. The different effective techniques are considered to find the suitable most efficient technique.
Findings: The various research works has been analyzed and evaluated. From the analysis, the Detecting Diabetes Mellitus and Nonproliferative Diabetic Retinopathy from tongue image is found to be better for Diabetic Retinopathy detection and also superior performance is achieved in terms of computational accuracy, precision , recall and F-measure.
Application/Improvements: Detecting Diabetes Mellitus and Nonproliferative Diabetic Retinopathy from tongue image are provides better result than other approaches

Keyword**:** diabetic retinopathy, Feature extraction, Classification.

1. Introduction

Generally, the diabetes categorized into four types. They are Insulin-dependent diabetes mellitus (IDDM), Non-insulin-dependent diabetes mellitus (NIDDM), Gestational diabetes mellitus (GDM) and Diabetes secondary to other conditions [1].

A fasting plasma glucose (FPG) test is the one of the standard methods for diagnose diabetes mellitus. FPG test demands for the patients to wait at least 12 h without food, and requires blood sample for analysis. Even though this method is accurate, it can be considered invasive, and slightly painful (piercing process).

Diabetes mellitus is simply called as DM which is a chronic disease with long-term macro vascular and micro vascular complications [2]. It includes the diseases like diabetic nephropathy [3], neuropathy and retinopathy. The medical nutrition therapy, exercise, insulin, and noninsulin agents are including for mostly used DM treatment. The main aim of the therapy is used to keep normal glucose levels in a blood throughout the day. The medical nutritional therapy and weight loss are enough for control the type 2 DM. Insulin therapies are sufficient for cure type 1 DM.

The Non proliferative Diabetic Retinopathy (NPDR) [4] and Proliferative Diabetic Retinopathy (PDR) are two types of Diabetes retinopathy. The non proliferative diabetic retinopathy represents the starting stage of diabetic retinopathy. In this stage, the miniature blood vessels within the retina leak blood or fluid. The escaping fluid leads the retina to form deposits which is called as exudates. It may reduce the vision of eye. The final stage of diabetic retinopathy is known as proliferative diabetic retinopathy. In this stage the blood vessels in the retina accept inadequate oxygen because of circulation problem. Here blood vessels are growing in order to keep sufficient oxygen level.

In [5] introduced an Automatic exudates detection scheme for diabetic retinopathy Screening. The Exudates are initial signs of diabetic retinopathy. The earlier detection of exudates leads to timely treatment. The automatic method is used to detect the exudates from retinal images of the patient. In order to improve the image quality, the preprocessing method is applied on retinal images. Then intensity, standard deviation on intensity, hue, and number of edge pixels are extracted from the pre-processed image. These features are supply to the FCM clustering method. The number of clusters is selected optimally by using FCM clustering technique. From the results, positive predictive value and positive likelihood ratio are improved. However, it does not considered more specific characteristics of exudates for improve detection accuracy.

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In [6] introduced an Automatic detection of Microaneurysm. Diabetic retinopathy (DR) is the generally cause a blindness in people of working age. Here the set of morphological operators are used for detect the microaneurysm on non-dilated pupil and low-contrast retinal images. Pre processing is a initial step for microaneurysm detection which is used to improve the quality. An exudates and vessels may lead to cause false discovery that is detected in second step. Vessels are removed from the image before detection of Microaneurysm. Finally, the Microaneurysm was detected on poor quality images. However it only detect the microaneurysm, it does evaluate the severity of the disease.

In [7] suggested a new mechanism for Detection and Classification of Diabetic Retinopathy. Diabetes is a leading disease which affects the human eye, its leads to Diabetic Retinopathy. The human retinal image is captured by using camera. Then the segmentation is performed on Retinal vascular. In order to detect haemorrhage candidates the density analysis and bounding box techniques are used. The Random Forests classifier is used for classifies the various stages of diabetic retinopathy. They are normal, moderate and non proliferative diabetic retinopathy (NPDR). However, an efficient classification algorithm is needed to achieve high accuracy.

In [8] suggested an Automatic Diabetic Retinopathy Detection approach using Fundus Images. In order to automate diabetic retinopathy detection system, the dark lesions in digital fundus photographs is detected. The detection of dark lesions in digital fundus photographs is used to develop an automated diabetic retinopathy screening system. Microaneurysms represented by small red dots on retinal fundus image which is a initial clinical sign of diabetic retinopathy. In order to find out the diabetic retinopathy, the Automatic detection system is introduced. The automatic system consists of three steps. There are preprocessing, feature extraction and classification. The preprocessing is used to eliminate the noise in Non-dilated RGB Retinal Fundus Images. The shape, size and intensity level features are extracted from image. Then finally classify the severity grade of grade the DR such as no DR, mild DR, moderate DR, and severe DR. The automatic detection system reduces the incidence of blindness. However, the efficient feature selection mechanism is needed to achieve high accuracy.

In [9] introduced a new method for identify the diabetic retinopathy stages. The microaneurysm detection in the input image is difficult task. In order to overcome this problem, the proposed algorithm is introduced. This algorithm consists of three stages. They are preprocessing phase, Enhancement phase and Microaneurysms detection phase. In preprocessing step, the median filter is used to remove the salt & pepper noise. After the Enhancement phase the Microaneurysms are detected in retinal image. In this system, a set of optimally adjusted morphological operators are used for microaneurysm detection in retinal images. The Sensitivity and Predictive value of this method is 98.89% and 89.70%. However, the detection accuracy is still investigated.

In [10] introduced Machine Learning approach for Diabetic Retinopathy Analysis. An introduced system analyzes fundus images with varying illumination and fields of view, and generates a severity grade for diabetic retinopathy (DR) by using machine learning. In order to reduce the number of features effectively, the Adaboost algorithm is used for feature ranking. The DREAM method consists of three steps. There are image segmentation, Lesion Classification and DR Severity Grading. The foreground candidate regions are detected after the completion of segmentation process. Then it classifies the bright candidate regions (RBL) and red candidate regions (RRL) as retinopathy lesions. Finally the severity grading can be measured. The DREAM system achieves efficient sensitivity and specificity. However it only detect severity of the diabetic retinopathy (DR) , it does not differentiate NPDR and PDR.

In [11] introduced a new model for Detecting Diabetes Mellitus and Nonproliferative Diabetic Retinopathy. In this system, the Color, Texture and Geometry Features utilized for detection. The tongue image is captured and pre-processed. Then colour features are extracted from pre-processed image. In order to represent the texture feature, the tongue image is separated into eight blocks. The 2-D Gabor filter is applied on tongue surface for compute texture features. Finally the geometry features such as distances, areas are extracted from tongue foreground image. In order to separate NPDR samples from healthy sample, the support vector machine classifier is used. However, it only achieves 80.52% accuracy.

II. Comparison of methodologies

From table 1, a better approach can be predicted that would provide considerable improvement in the proposed scenarios.

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Table 1. Comparison of Research Methodologies

Reference	MERITS	DEMERITS
[5]	High detection accuracy High sensitivity	It does not considered more specific characteristics of exudates for improve detection accuracy
[6]	High sensitivity High specificity High precision High accuracy	It does evaluate the severity of the disease
[7]	High accuracy High sensitivity	Optimal classifier is required for achieve improved accuracy.
[8]	Better Sensitivity and Specificity	Efficient feature selection mechanism is needed to achieve high accuracy.
[9]	It achieves high accuracy while taking very poor quality images	detection accuracy is still investigated
[10]	It reduces the average computation time High accuracy	it only detect severity of the diabetic retinopathy (DR) , it does not differentiate NPDR and PDR
[11]	High average accuracy High precision High recall	It requires further improvement

4. Conclusion

In this research various diabetic retinopathy detection mechanism are evaluated and compared. Detecting Diabetes Mellitus and Nonproliferative Diabetic Retinopathy from tongue image method provides higher performance than other techniques in terms of accuracy, precision, recall and f-measure.

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We the authors assure the readers that, this is authors' own work and there is no conflict of interest.

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