European Journal of Molecular & Clinical Medicine
ISSN 2515-8260 Volume 7, Issue 9, 2020

AN EFFICIENT EARLY DIAGNOSIS FOR DIABETIC RETINOPATHY USING QUICK CONVOLUTIONAL DIAGNOSIS

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Abstract

Diabetic retinopathy (DR) is derived from diabetes is a serious eye disease and in the most common cause of blindness. DR is an eye disease that is a result of chronic disease of diabetes. A microaneurysm is a small red spot in the retina that raises from the fragile part of the blood vessel, hard exudates, and abnormal growth of blood vessels are the diabetic retinopathy. Predicting the presence of microaneurysmsas an early indication of fundus imaging and diabetic retinopathy has been a major challenge for decades. DR is suffering from a person's chronic high blood sugar levels, microvascular problems, and irreversible vision loss leads.To solve this problem, the rapid advancement of Deep Learning (DL) makes it an effective technique for providing interesting solutions to analytical problems in medicine.The proposed system DL algorithms are Retinal Hidden Linear Selection (RHLS) algorithm and Quick Convolutional Diagnosis (QCD)algorithm. Retinal Hidden Linear Selection (RHLS) algorithm used to pre-process to remove noise from the fundus image, and excessive-performance. Then, a quick convolution diagnosis (QCD) algorithm is a classification to determine whether the fundus image is subjected to a normal or influence. The results obtained are the proposed method, from a very effective and color fundus image shows a successful diabetic retinopathy diagnosis.

Keywords: QCD, RHLS, color fundus image, Classification, Preprocessing, DL

1. Introduction

According to the International Diabetes Federation (IDF) diabetes, it is more than 4.25 billion people, are affected by diabetes. Statistics show that tens of millions of box

attack has increased in the past two years. In 2015, have been reported and 415 million people. People who live in low-and middle-income countries, more susceptible to AIDS. The report is that in the next few years, become diabetes 6,290,000 people in the world. Diabetic retinopathy (DR) is a condition that causes damage to the eye retina. The problem is, not to the millions of people around the world, has been going on by all of the tools needed to diagnose diabetic retinopathy that is exposed to the doctors and the general public.

Diabetes is classified as type 1 or type 2 diabetes. Type 1 diabetes treatment is difficult and deadly, but type 2 diabetes, can be cured when you enter early. It can be detected by analysis of the retina in diabetic retinopathy that type 2 diabetes is known. Image processing technologies have been used by many researchers to detect the presence of DR in the retina.Type 2 diabetes is a common illness due to physical activity and stress. Diabetic forms include the retina, kidneys, and nervous system. Diabetic retinopathy in the eyes due to changes in diabetes, similarly, with kidney defects are known as diabetes mellitus. The flow of lipoproteins in the DR is due to the bursting of the nerves and the weakening of the blood vessels.

Patients and their families diagnosed with diabetic retina can be treated appropriately, which can prevent severe vision loss and blindness by maintaining an adequate quality of vision to relieve the disease. In addition to the obvious medical benefits, it is sustainable growth, must be achieved by significant positive economic results to maintain patience and self-operating. The main cause of blindness in the world, is DR. Diseases, for example, aneurysms, such as capillaries and erythema retina hemorrhage, at high vascular permeability onset symptoms of high fatty myocardial infarction has been implicated in several disorders in the fundus.

Micro aneurysms kinetics increase the risk of those who are mainly developing the stage of laser photocoagulation needs. Progress of the generally accepted pathology and DR of the retina can be slow in the initial stages of the disease only. These initial lesions (mainly microaneurysm and a small number of blood cells), patients affected have been studied to identify new opportunities for improving the treatment of the recurrent retina. Floating or flickering, blurred vision, sudden loss of vision, might be common symptoms of diabetic retinopathy.Diabetes of the retina blood vessels allows the retina, bleeding, exudates damage, and the presence of new blood vessels to be seen in the loss of vision or obstruction of diseases. Developmental and non-developmental stages: a two-stage disease progression.

Early proliferative and Non-proliferative stages detection (NPRD) therapy is an important one. Hard exudation, is one of the diabetic retinopathy symptoms of early detection.

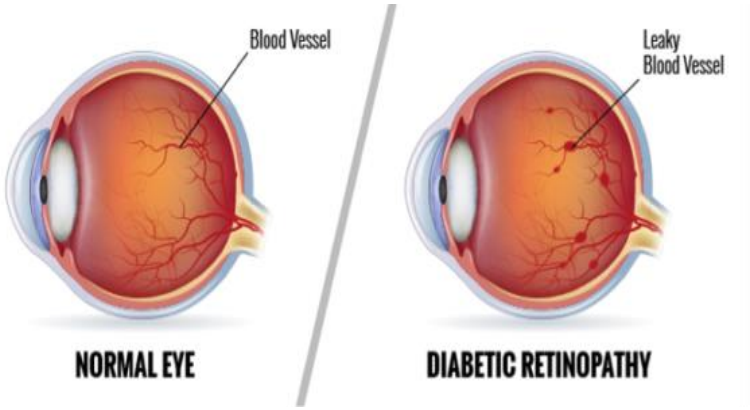

Figure 1: Diabetic Retinopathy

[https://plessenophthalmology.com/diabetic-retinopathy/]

A person with diabetes may be asymptomatic in the early stages and may be suffering from this for several years before it is diagnosed. Over time, the kidneys, peripheral nerves, feet, heart, and eyes are particularly vulnerable to circulation. If you have numbness or loss of consciousness in your legs, it seems that you have started to have what is referred to as peripheral neuropathy. This means that peripheral nerve damage reduces blood flow. Usually, when a person has a neurological illness, he or she has diabetic retinopathy.

When the swelling and moist, this leakage will reduce the sensitivity of the retina. In this way NPDR, many of the symptoms of retinal bleeding as a fine aneurysm, absorbent cotton (CWS) is, and follow the hard exudate, can be added hard exudate (HE). Also, NPDR, depending on the number and incidence of these lesions, mild, moderate, has been divided into severe of three stages.

Fundus imaging, because it is considered a candidate for the non-invasive screening, fundus imaging plays an important role in the diagnosis of the retina of diabetes. This type of success methods screening for the correctness and robust image processing and analysis methods for particular detecting an abnormality rely on accurate fundus image capture.

2. Related Work

Diabetes mellitus is a group of causes of long-term high blood sugar and metabolic diseases in the so-called chronic disease [1]. Values, data validation, feature selection, using

the K times cross-validation, and various machine learning (ML) classifier, missing outliers existing refuse reasonable framework for predicting diabetes.

Diabetes can lead to blood sugar, which can cause the insulin in the body is increased, leading to several complications that affect such eye, kidney, nerve, such as the normal functioning of various organs. Diabetes classification, imbalance data on unbalanced data, and missing values (DMP_MI) [2]. First of all, the normalization of the data of the missing values will be compensated by the author of the naive Bayes (backup) method. Since then, the adaptive synthesis sampling method has been adopted to reduce the influence of the class level of performance variations.

Early prognosis is, before it's too late and plays an important role in improving the quality of medical care, you can help the individual to avoid a dangerous health condition. Of a disease prediction model (DPM) as individual risk factors, it is to provide a preliminary prediction based on type 2 diabetes and hypertension. Technical SMOTETomek link (SMOTETomek) oversampling existing combined small number compiles several types of duplicate outlier distributed equilibrium data technical data for prediction Another forest base (I Forest) disease of including an integrated model) anomaly detection system[3].

HbA1c value is an important indicator of the important measure to control successfully the long-term average blood glucose, any type 1 diabetes. The previous system, we have the evaluation of HbA1c can be obtained from the daily blood sugar measurement of 5 to 12 weeks. They are, when the measurement cycle is insufficient, however, these methods suffer from low accuracy. The purpose of this study is to improve the accuracy and stability of these glitches and hemoglobin predicted time series glucose [4]. Prediction model of deep learning and new data-driven HbA1c value based on the neural network convolution.

Prediction of non-invasive diabetes is becoming increasingly important in the past ten years. After reviewing several human sera, acetone levels, human breathing, it seems to be a promising option for a good relationship between blood sugar levels and breathing. This establishes the acetone as acceptable biomarkers for exposure to diabetes. For the most common data analysis techniques [5] diagnose respiratory biomarkers for diagnosis uses feature extraction and classification methods. Existing methods, thereby further classification performance improvements, we are at significantly only been found to reduce the limitations associated with using these strategies.

Linear empirical models are used for the prevention of blood glucose prediction and risk for people with wide type 1 diabetes. Long prediction horizon (PH), a more accurate blood glucose prediction model, to avoid blood sugar, should be able to remind the patient that there is not enough time to correct the situation. Blood glucose prediction system, the season has been developed by a set of local model [6] (each of which matches the historical data of different glucose distribution space). The modeling process, relevant amount, and distribution of synthetic techniques and glucose characteristics of (Fuzzy C Intermediate) are obtained by the clustering distributions.

Model and the classical autoregressive and external input (ARX) model of some of the well-known machine learning (ML) has been used for time-series data and the prediction types1 of patientPerformance of diabetes (I type diabetes). How: ML algorithm, ML-regression model and depth learning model of such a long and short-term memory, (LSTM) to evaluate different input function according to the network and temporal convolution network (TCN) regression model, and sum method or blood glucose (BG) will be mentioned. Direct means of multi-step prediction should be performed in the practical [7] Problems. Power/hyperglycemia event, the increase in performance measurement time gain time, and to predict the secondary differential energy (ESOD) sequence of the predicted performance measures, including average root, mean square error (RMSE).

Continuous glucose monitoring systems (CGMSs) produce a significant amount of data, which allows the measurement of blood glucose levels in diabetic patients from a high sampling rate. These data effectively can be used for peripheral future values of blood glucose concentration, enabling early prevention of dangerously high or low blood sugar states and better optimization of diabetes treatment. A large number of patients in the multidisciplinary group practiced blood glucose signals, and then the prediction model was used to predict future glucose levels in an entirely new patient [8]. To do this, it has been proven to be successful in comparison, each of the plurality of time-series prediction, nonlinear autoregressive neural networks, and the long-term and short-term storage network, each, for two different types of solutions it has been proposed to.

Treatment of type 1 diabetes (T1D) should be based on monitoring glucose to avoid external insulin administration for high / low blood sugar. Clinical trials take a day-to-day much time, is inexpensive, and the safety and insulin treatment, and evaluation. T1D is a patient's glucose, insulin, and glucose kinetics, UVA / Padua T1D models, pseudo monitoring

glucose development, the result of the treatment of patients, a combination of such devices as a continuous glucose monitoring module, such as self-monitoring blood glucose (SMBG) insulin behavior manager describing the run through [9].

Relating to metabolic syndrome using situational risk factors, and) surveying machines; 2. Relationship between diabetes and metabolic syndrome (metabolic syndrome) and personal risk factors in non-conservative settings. The purpose of the process is to explore the use of data modeling techniques to create future predictions of diabetes, which balance the comparative effectiveness of training sets. Measuring individual risk factors for diabetic metabolic syndrome has been contributed to the development of logistic regression analysis in a non-conservative setting [10]the current analysis, diabetes is often inconsistent with the view that is associated with a low level of high-density lipoprotein (HDL).

It will be the advancement of technology to adjust the artificial pancreas (AP) system or closed-loop blood sugar. Its purpose is while tightening the level, is to reduce the burden of the current diabetes patients. Nevertheless, such as a diet and exercise, a major obstacle, a huge challenge to be present in the fully closed-loop system. BG control and type 1 diabetes patients who have been diagnosed with physical activity were discussed. It is used to inject insulin and supplements carbohydrates for control strategies hypoglycemia. The insulin mechanism is based on insulin feedback and nominal safety auxiliary feedback element (SAFE) layer, it is predicted by the algorithm. The proportional-derivative controller is based on the size proportional differential control. [11].

Graphics processing units (GPUs) may become available to a new generation of graphics, and increasingly cloud computing services can be used in clinical applications with parallel computing. Also, deep learning is suitable for computing workstations that typically have multiple units that allow large data sets to be distributed when used in parallel on each GPU distributed among multiple workloads. Type 2 diabetes mellitus (T2DM) patients and deep learning techniques for predicting adverse events using the classic machine, assessing F1 as an indication of accuracy, precision, recall, and evaluation of conducted and used symptoms [12]. Best performance for predicting acute myocardial infarction, the balance of the linear discriminant analysis (LDA), and support vector machine (SVM), obtained by the accuracy of the weight and models.

The number of breast cancer patients, especially as the aging of the population, has increased. The procedure, using mammography for screening, better, potentially, more

efficient. When it comes to medical imaging, the room for improvement is always there. Early detection of cancer, can reduce the risk of death in cancer patients. Deeper learning methods are two of the demonstration network for the detection of breast cancer. The entire upgrade process, image pre-processing, including the classification and performance evaluation [13]. It has a deep learning model, network performance, it uses the IRMA data set VGG16 and ResNet50 to classify the defect of a normal tumor.

Deep Learning Feature Disassembly and Modeling has shown it's intrinsic and advantages to fit it. It has been used in the field of broadcasting and collaboration to verify data with drones to detect defects in promotion and transmission devices. Abnormality is used to improve diagnostic accuracy and many other important object diagnostics. Pre-process images and enable parallel image prediction [14]. Includes image pre-processing, defogging cycle, and finally target detection through link logic judgment.

All of the artificial intelligence systems have the training needs of big data. More specifically, the image of the object detection artificial intelligence, you need a large-scale training. This is, by training a crawler on the Internet, you can download from the Internet. However, most of the cases, the image that is collected by crawlers, is often inaccurate. [15] Without proper pre-treatment, you will not be able to use the workplace training data of any of artificial intelligence. Preprocessing system for training track for the collected image by YOLO. It will be the integration of the system is possible.

Gear failure, because mainly occur in the microstructure or material level, only their effects can be monitored indirectly at the system level. Early detection of gear surface can be presented with significant challenges. The classifier is then used to rely on extraction from features of a system for detecting the characteristics of the gear failure. Deep rotation is based on a neural network transmission learning method. A learning system, it was suggested that consists of two parts. The first part, using extracts from the automatic input, is constructed with a pre-training deep neural network, and the second part is completely the gear that requires misclassification of train functions it is connected. Test data platform [16].

The new sensor technology is the automatic detection of kidney disease. The concentration of urea in the saliva has been monitored. The new detection method has been introduced to monitor the level of the sample of urea. Further, to analyze the received signals of the sensor, the depth of the one-dimensional is realized, and the support vector machine (SVM) neural network (CNN) algorithm convolutional built into classifier [17] Learning Has

been done. The integration of the classification accuracy network will be used to strengthen Flights from CNN-SVM.

Automated classification based on deep learning for the treatment of frequency of worsening chronic obstructive pulmonary disease (COPD). Three-layer Deep Belief Network (DBN) consists of two hidden layers and a visible light layer to create a derivative model and analyze the degeneracy of model power. Subjects from the COPD gene family were defined as the number of episodes per year marked by the frequency of worsening [18]. The DBN weights feature different layers that have a good visual-spatial relationship between the basic key in analyzing the performances. Survey results indicate that the DBN is the most sensitive consensus medical authority and the diagnostic criteria for COPD.

Parkinson's disease (PD) is a progressive neurodegenerative disease with many kinetic and non-motor characteristics. Patients with PD face vocal cord injuries in the early stages of the disease. Therefore, the vocal cord-based diagnostic system is the precursor of a recent PD diagnostic study. Two structures based on convolutional neural networks have been proposed to use multiple groups of voice functions, Parkinson's disease. Previous models were trained from the dataset at the UCI Machine Learning Library and their performance Leave-One-Person-Out Cross-Validation (LOPO CV) verification [19]. Due to our data random class distribution F-measure and Matthews correlation slope indicators are used to accurately estimate.

A new deep learning system, deep-mass dictionary learning for medical multidimensional diagnostic analysis. The traditional dictionary learning method, which avoids the relationship between model and dictionary atoms, essentially combines the existing value mechanism into the dictionary atoms. At the same time, the use of data sets is dominated by patients using classical dictionary learning methods. The previous method professed profound dictionary learning. Layer train thinking layer, along with hidden layers, so that local information between layers can maintain their properties, reduce the risk of overlap, and improve the training and learning accuracy that each layer of the network can accumulate [20].

3. Materials and method

Diabetes can be caused by high sugar that is in the blood. Diabetes can cause diabetic retinopathy if it is not cured early. High blood sugar can affect the small blood vessels and

cause the nervous system (diabetic neuropathy), which is known to be a major risk for diabetic retina, kidney, and cardiovascular disease. The patients with DR are determined from the retinal fundus color image. Color fundus images are widely used for early detection of the diabetic retina. Early detection of diabetic retinopathy by detection from microaneurysms in the fundus image. Microaneurysms are the first important indicator of retinal red spots in any diabetic retina. They appear as a small red swelling in the retina. Microaneurysms cause blood vessels are leaked in the retina. The proposed system microaneurysms fundus disease image in the retina can accurately early detect and predict the risk of Diabetic Retinopathy using deep learning (DL) methods. The proposed DL algorithms are Retinal Hidden Linear Selection (RHLS) algorithm that is used to preprocess the fundus image to remove noise and suppress unwanted distortions. Quick Convolutional Diagnosis (QCD) is used to classify fundus images that are normal or infected, which can improve efficiency, accuracy, and prediction in the low time. The proposed method QCD for early prognosis of fundus image can effectively predict non-diabetic retinal detachment.Diagnosis of diabetic retina consists of three stages from color fundus images there are pre-processing, feature extraction, and classification.

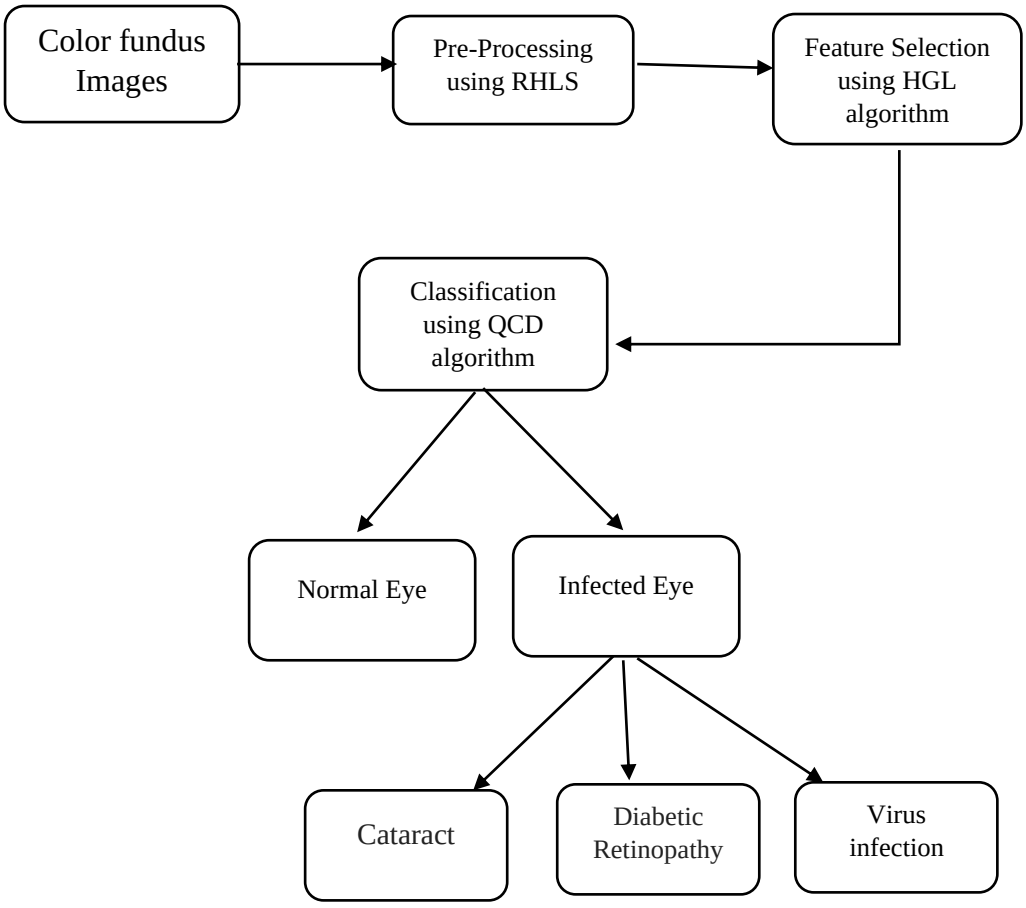

Figure 2:Block Diagram

Pre-processing is important for detecting microaneurysms because medical images suffer from some noise, but rather in poor condition. So it is to remove using pre-processing of the fundus image is done to improve the contrast.Feature selection plays an important role in computer vision. Can be used to provide extracted features tutorials on the parameters of the classifier.DR classification is performed by Quick Convolutional Diagnosis (QCD). This is a huge success for QCD classification to improve DR detection.

3.1 Pre-Processing

Retinal Hidden Linear Selection (RHLS) is a common method of image pre-processing characterized by the image process. Pre-processing Involves distillation, normalization, fragmentation, and object identification. The output at this point is a set of key areas and items.The retina color fundus images often show light changes, poor contrast, and noise. So, the stage has to go to pre-processing these images. Enhancement is necessary because the fundus image suffers from non-uniform lighting and noise. It is used to remove noise, unwanted data. To improve contrast, the fundus image is preprocessing. This fundus image pre-processing be a step, which is to improve efficiency.

Algorithm Steps

Input: Fundus image Dataset

Output: Pre-processing image Dataset

Start

Step 1: Initialize the fundus image

Step 2. Read the fundus image

Step 3: Resize the image

Step 3. An accurate image of the process

Step 4.Improve clarity and remove noise from the fundus image

Exit

In the steps of this algorithm, some fundus images are collected, which makes the microaneurysms of the fundus image very sensitive from the DL process. The smoothest

method when preprocessing to remove noise to using the Retinal Hidden Linear Selection algorithm.

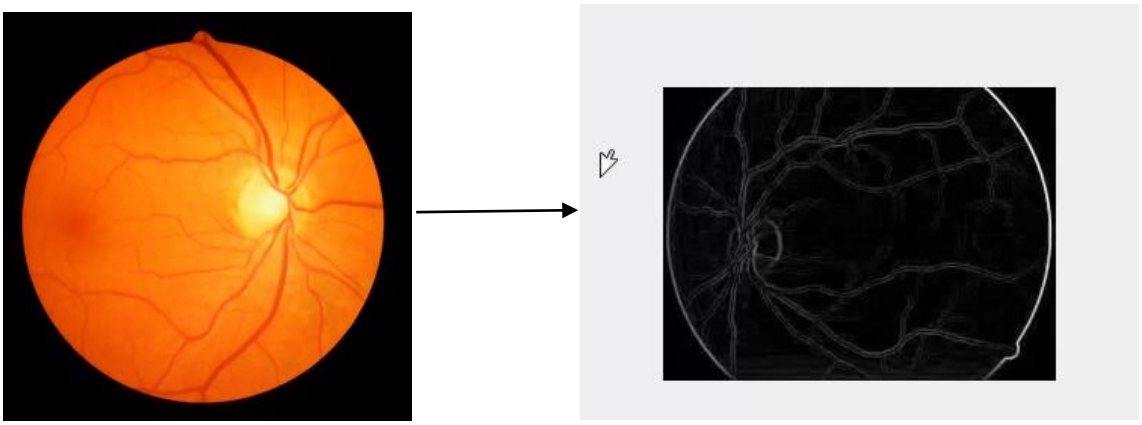

Figure 3: Preprocessing

Figure 3 above shows the pre-processing of fundus images.It removes unwanted data and noise from the fundus image. To improve contrast, the fundus image is processed. The fundus image pre-processing is a step is to improve efficiency.

3.2 Feature Selection

Feature selection is done after the preprocessing stage of fundus image processing is using the Haralick Grey Level (HGL) method. HGL is based on calculating the level of fundus images. Feature selection and classification of information related to each class is an important step in any system classification and target extract relevant information. In this process, the fundus images are derived to form the corresponding features as feature vectors. This fundus image feature selection is then used to identify the input via the classifier and the target output unit. It makes viewing these functions to differentiate between different categories because it makes it so much easier to distinguish.Features involve such as shape, texture, color, etc., are used to describe image content. Image features can be divided into sources.

Algorithm Steps

Input: Pre-processing fundus images

Output: Feature selection images

Start

Step 1.Initialize Pre-processed fundus image acquisition

Step 2.Collected training data set

Step 3. Convert gray level fundus images

Step 4. Find the best feature image dataset

Exit

In the algorithm steps, Feature selection is the process of obtaining the most important image shape or edge based on the information obtained by the original. Facility Extraction requires finding a set of parameters that precisely define the shape of a character and are unique.

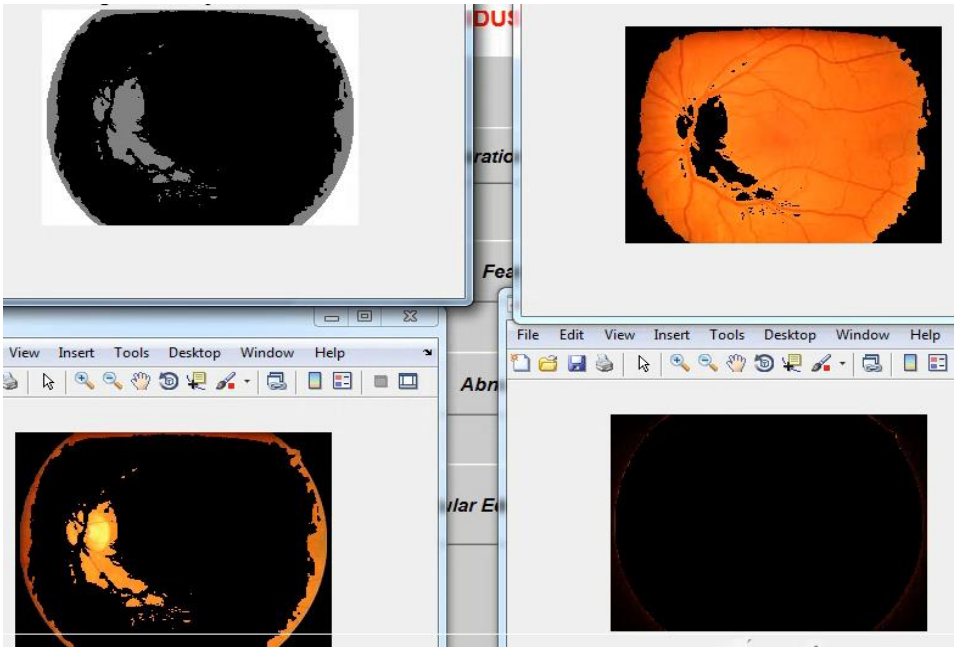

Figure 4: Feature Selection

The above figure 4 shows the features selected from the fundus image. Feature selection is used to identify some features of the retinal size, color, texture, and shape of the retina image.

3.3 Quick Convolutional Diagnosis

QCD is a classification for DR detection is being used. DR eyes and healthy eyes are divided into two types, such as QCD classified images. The color fundus image features parameters were calculated based on the QCD classification.The QCD parameters are trained in the Maintenance Package using two input functions such as partial and numeric. The average number and mean area of microaneurysms are considered at the threshold of DR classification. It is used to classify the color fundus images, which can be classified as a

normal eye or infected eye, which can improve efficiency, accuracy, and prognosis in less time. The proposed method for the early prognosis of fundus images QCD can effectively predict diabetic retinal detachment.

Algorithm Steps

Input: Feature selection fundus images

Output: Classify normal eye or DR eye

Start

Step 1: Initialize the Feature selection fundus image

Step 2:Read the feature selection images

Step 3: Analyze fundus images

Step 4: if ((EA==0) || (Bv<=170) || (MA<=150) && (OD<=928) || (HA<=180))

Normal Eye

Else

Infected Eye

Exit

EA= Exudates Area, Bv = Blood vessel area,MA = Microaneurysm, OD - Optic disc, HA = Hemorrhage.In this algorithm step, fundus classifies images as normal eye or infected eye.

4.Result and Discussion

The Results and the proposed implementation execution results will be tested on the Matlab with the fundus image dataset shooting site. Performance appraisal testing Sensitivity, Specificity, and Classification accuracy results obtained during the re-execution phase. The test results are compared with the existing method of the Ensemble-Based system (EBS), Prognosis of Microaneurysm non - proliferative diabetic retinopathy (PMNPDR), and the proposed method is Quick Convolutional Diagnosis (QCD).

Table 1: Simulation parameters

Parameters used	Values processed
Input dataset	Indian diabetic retinopathy image dataset
Simulation tool	Matlab 2017 a
Number of images	81

Trained images	54
Testing images	27

Table 1 shows the color fundus image dataset that has been processed to test the performance of the proposed system in detail.

4.1 SensitivityAnalysis

Detection of DR can be a fundus image, link, or image pixel. Sensitivity tests are a fragment of the ratio of positive reactions or true positive ratios classified correctly.

$$\text{Sensitivity}=AP/(AP+FN)\times 100 \text{------- (1)}$$

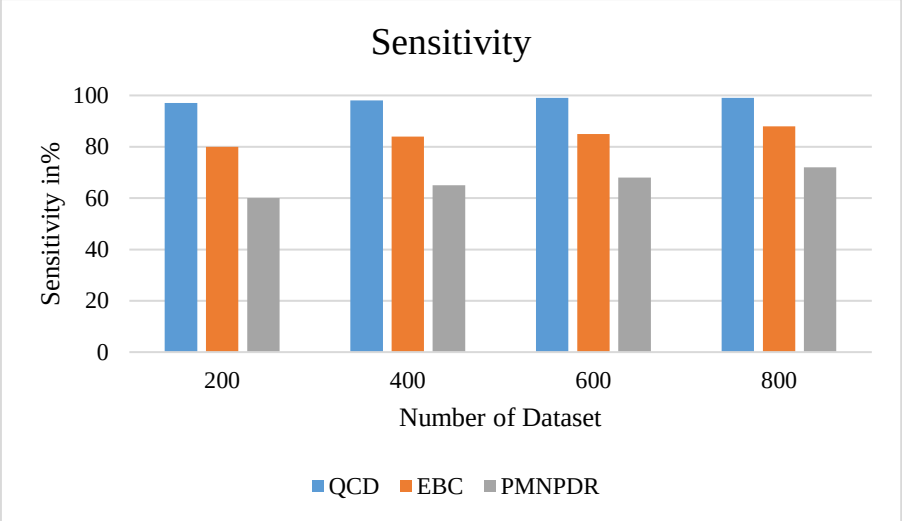

Figure 5: Performance of sensitivity analysis

Where AP – Actual Positive, FN – False-negative.A diverse pattern was observed from different fundus image datasets. DR specificity is shown in figure 5, which produces higher efficiency ratios than other methods of implementation above true positive accuracy. The accuracy of this proposed method results in 98%, as well as the existing system Prognosis of Microaneurysm non - proliferative diabetic retinopathy (PMNPDR), Ensemble-based system (EBC) providing 72% and 88%.

4.2 Specificity Analysis

Specificity positive predictive value properly rated Positive Values or True Negative rates ratio rated negative values are rated as part of the rated value.

$$\text{Specificity}= AN/(AN+FN)\times 100 \text{ ----- (2)}$$

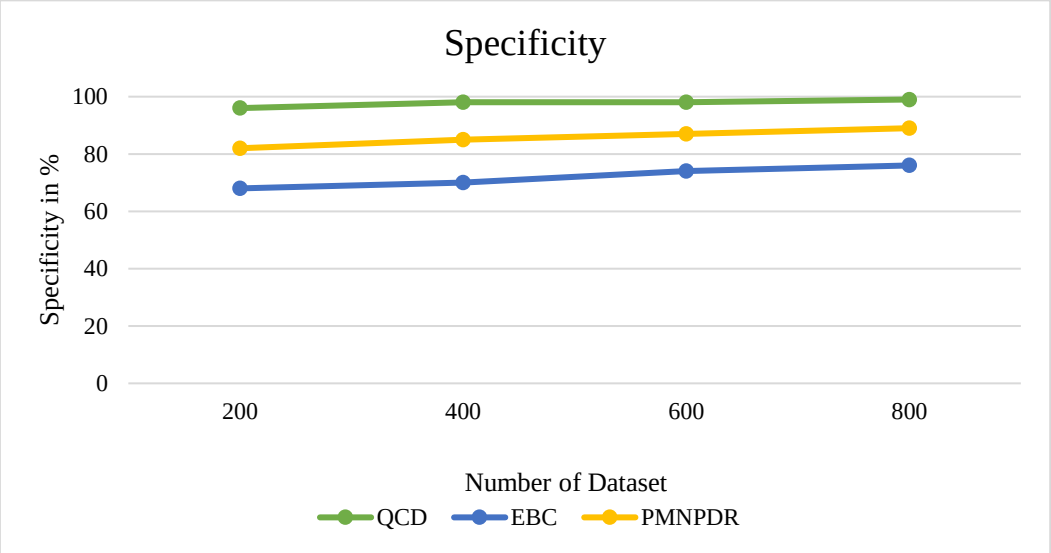

Figure 6: Performance of specificity analysis

Where AN-Actual Negative, FN- False Negative. Figure 5 uses the specificity analysis of different fundus images. Different test values were generated in different ways in the database. The proposed system is a specificity of this greater than other methods, and the QCD gives a review of the proposed method for analyses the specificity ratio is 98%. Similarly, existing methods EBC and PMNPDR provide 76%, 89% results, respectively.

4.3 Accuracy of classification

The proposed method for classification combined with the classification accuracy improvement method in the microaneurysms fundus images proved its effectiveness. The purpose of the evaluation cycle is therefore determined by their successive images.

Classification= (AP+AN)/ (AP+AN+FP+FN) x 100 ------ (3)

Table 2: Classification Evaluation

Number of dataset	EBS in %	PMNPDR in %	QCD in %
200	64	75	92
400	68	78	95
600	71	81	97
800	75	86	98.9

Where AP- Actual Positive, AN- Actual Negative, FP- False Positive, FN- False Negative. Table 2 shows the proposed QCD system classification accuracy assessment.

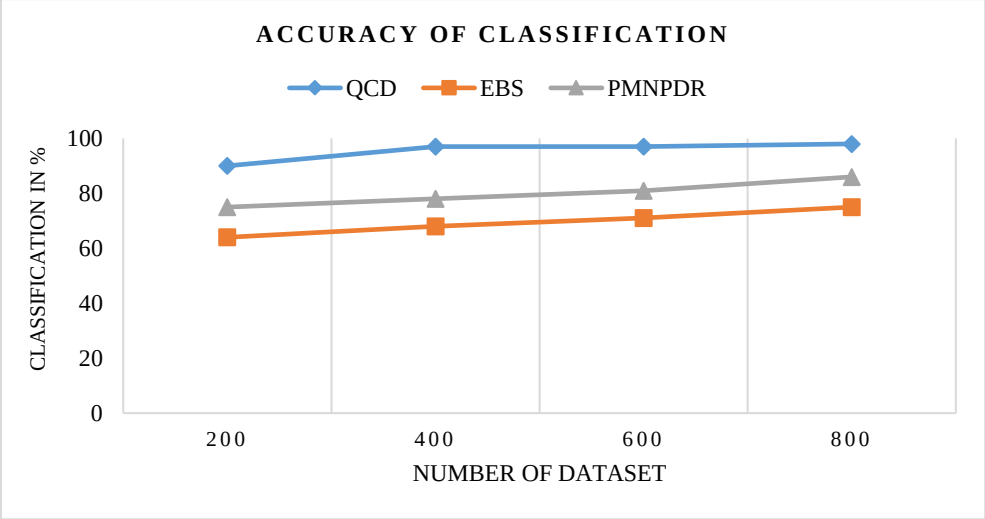

Figure 7: Accuracy of classification analysis

Another method shown in figure 7 builds to make the accuracy of classification for fundus images at different levels above. The proposed system predicts a greater impact and more accurate results for classification performance than many other methods. As a result, the proposed by this method at microaneurysms fundus images classification of accuracy gives is 98.9%, as well as the existing methods, provide EBC and PMNPDR offer 75% and 85%.

5. Conclusion

The enhanced scheme proposed in this novel is used to diagnose diabetic retinopathy precisely determined by the microaneurysms color fundus images identifying the normal eye or DR eye using deep learning algorithms. The proposed algorithm Retinal Hidden Linear Selection (RHLS), and Quick Convolutional Diagnosis (QCD) proved to be more efficient than other existing methods. The proposed method gives the sensitivity ratio is 98%, specificity ratio is 98% and the accuracy of classification is 98.9% are proven high performance compared to other existing methods.

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