APPROACH FOR DIABETIC RETINOPATHY ANALYSIS USING ARTIFICIAL NEURAL NETWORKS

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Abstract – *This paper is review of an automatic segmentation method used to detect cotton wool spots in the retinal images for diabetic retinopathy disease which affects up to 80 percent of all patients who have had diabetes for last 10 years or more. Early detection and proper treatment DR is important to prevent further complication or to control the progression of the disease.   The retinal image has been preprocessed to enhance the quality of image. A feature extraction method was used to take useful elements from the retinal image. A neural network model was used for learning task and tested by k fold cross validation. Our approach is to analyze DR image by using one of the Multilayer perception neural network, Support vector machine, Generalized Feed Forward Neural Network methods to get the 100% result.*

Key Words: Diabetic retinopathy (DR), Artificial Neural Network (ANN), Medical Image Processing, Fundus Images Analysis, (RGB) Red Green Blue. Computer vision 2 (cv2) libraries.

1. INTRODUCTION

Diabetic retinopathy (DR) is damage in the eye due to diabetes which may occur due to changes in blood glucose level that may lead to changes in retinal blood vessels. It is normally considered as the most common cause of vision loss for the past 50 years. Diabetic retinopathy is vision frightening that occurs in persons with long standing diabetes with progressive damage to the retina of the eye and a leading cause of blindness among working adults if it remains untreated. It can be perceived during dilated eye examination by an ophthalmologist or optometrist. Early detection and proper treatment of DR can help to avoid blindness [1]. DR is broadly classified into proliferative diabetic retinopathy (PDR) and non-proliferative diabetic retinopathy (NPDR). In the event of PDR the blood vessels in the retina of the eye get blocked and avoid flow of blood in the eye. Whereby new, but weak vessels begin to form on the retina which supplies blood to the closed area. In the event of NPDR extra fluid will get leaked from the damaged blood vessels along with little amount of blood. This situation leads to the formation of exudates in the retina of the eye. As the disease advances, the quantities of the exudates also gain. Figure 1 and Figure 2 show the normal retinal image and DR affected image 2016.
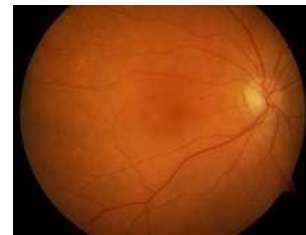

Fig.1. Normal retinal scan image

Fig.2. Diabetic Retinopathy infected scan image

Diabetic Retinopathy (DR) is the retinal bruise, caused by elevation of blood sugar levels, which can ultimately lead to vision impairment. According to the World Health Organization, It has been estimated that more than 75% of people who have diabetes for more than 20 years will have some form of Diabetic Retinopathy. Diabetic Retinopathy is asymptotic in the beginning and therefore many diabetic patients are not aware of their condition until it affects their vision. Early and regular screening of DR is therefore very important to prevent further complication or to control the progression of the disease. Microaneurysms (MA) appear as tiny reddish dots in the peripheral retinal layers. With the progression of the disease, smaller vessels may close and new abnormal blood vessels begin to grow in the retina and are referred to as proliferative stage. This stage may lead to vision impairment and if not treated properly would eventually turn to vision loss.

Research in the field of medicine suggests that abnormal pressure and glucose levels are a major cause of several critical ailments. Such aberration can lead to other complications in various organs of the body. In this Purposed work we place focus on Diabetic Retinopathy, the former being a disorder in the retina of the eye caused mainly due to Diabetes leading to imperfect/loss of vision and the latter being associated with elevated pressure in the eye causing damage to the optic nerve .Diabetic Retinopathy are asymptomatic in the preliminary stages and findings reveal that treatment may be useful only when detected early.

Regular screening of the people who have high risk of the disease may help detect the disease at an early stage. Detecting retinal abnormalities in a large number of images generated by screening programs is a time-, resource and labor – intensive task. Automatic detection of the disease from the retinal images is thus an important area of ongoing research.

2. LITERATURE REVIEW

Toan Bui, Noppadol Maneerat, proposed an evaluation method based on a number of pixel samples to detect number of the cotton wool blobs. The proposed method was applied to DIARETDB1, a popular public database for any research based. They were use color features as red green blue (RGB) space, intensity and the texture features as contrast, range, mean, and entropy. An optic disc removal was applied to enhance image quality of database image. A feature extraction method was used to take useful elements from the database image. This method was used for increasing accuracy in classification step. A neural network model was employed for learning task and tested by k fold cross validation. The method was also calculated the percentage of the cotton wool blobs [1].

Saket Kanth, Anamika Jaiswal, Misha Kakkar, proposed the identification and classification of normal, non proliferative diabetic retinopathy (NPDR) or proliferative diabetic retinopathy (PDR) affected eyes. It strengthens the idea that multilayer perception can be used efficiently as a classifier for detecting eye related diseases in fundus images. Recognize different stages of diabetic retinopathy and differentiate it from a normal eye with the study of fundus images. Features were extracted from these images and fed into the multilayer perception (MLP) for classification [2].

Xingzheng Lyu, Hai Li, Yi Zhen, Xin Ji, proposed a model for detecting tessellated images using convolutional neural network. For differentiating tessellated retinal images from normal retinal images convolutional neural network based models was build. For training and testing of these models a large image dataset was used. The preprocessed fundus image was the input. The input was tessellation or not is the output. These models all show competitive tessellation classification performance [3].

Z. A. Omar, M. Hanafi, S. Mashohor, proposed to detect exudates, blood vessel and hemorrhages of Diabetic Retinopathy detection method. Using 49 and 89 fundus images, the algorithm was trained and tested the fundus images. All the fundus images were categorized into four diabetic retinopathy stages, namely mild Non-Proliferative Diabetic Retinopathy (NPDR), moderate Non-Proliferative Diabetic Retinopathy, severe Non-Proliferative Diabetic Retinopathy and Proliferative Diabetic Retinopathy (PDR). The detection for exudates having high percentage than blood vessels and haemorrhages. Due to the condition of the image itself, some parts of the Diabetic Retinopathy features could not be detected by the system. [4]

Enrique V. Carrera, Andres Gonzalez, Ricardo Carrera, proposed classification of the grade of non-proliferative diabetic retinopathy at any retinal image. In order to extract features, used by a support vector machine, an initial image processing stage isolates microaneurysms, blood vessels and hard exudates. To figure out the retinopathy grade of each retinal image used by a support vector machine. The evaluation was implemented in the software MatlabR. Getting better result of support vector machine (SVM) than other machine learning algorithms. [5]

Wei Zhou, Chengdong Wu, Dali Chen, Zhenzhu Wang, Yugen Yi, Wenyou Du, proposed retinopathy online challenge (ROC) dataset, to detecting the Microaneurysm algorithm which integrates multiple channels multiple features into a framework and joint dynamic sparse representation with multiple-channel multiple-feature dictionaries. In terms of adaptability and certifies the effectiveness, this method was more reliable than the other methods. [6]

Deepthi K Prasad, Vibha L, Venugopal K R, proposed the use of morphological operations and segmentation techniques for the detection of blood vessels, exudates and microaneurysms. An effective method for feature selection, Haar wavelet transform followed by principal component analysis was used. Haar wavelet transformation is reported to be one the basic, novel and faster method for dimensionality reduction. [7]

Ketki S. Argade, Kshitija A. Deshmukh, Madhura M, Narkhede, Nayan N. Sonawane, Sandeep Jore proposed the determination of retinal images using appropriate image processing and data mining techniques, to classify normal and abnormal retinal images. Data mining technique specified classification techniques to accurately categorize the disease and the feature relevance. [8]

Arslan Ahmad, Atif Bin Mansoor, Rafia Mumtaz, Mukaram Khan, S.H.Mirza, Proposed the detection of diabetic retinopathy, they were reviews the latest techniques in pattern classification and digital image processing. It compares them in receiver operating characteristic, on the basis of different performance measures like specificity, sensitivity, area under the curve and accuracy. The diabetic retinopathy classification takes place by following various steps like pre-processing, feature extraction and classification of microaneurysm, hemorrhages, exudates and cotton woolen spot. [9]

Rubeena Banu, Vanishri Arun, N Shankaraiah, Shyam V, proposed classification of Diabetic Retinal Images using Meta-cognitive Neural Network Method. This proposed work was to classify the exudates retinal images and non-exudates images automatically. Firstly the pre-processing and optic disc elimination happened and then four main features are utilized for classification. To reduces the memory requirement and computation time by discarding the same samples from the training input data samples and also avoid over training by using Meta-cognitive Neural Network

(McNN) classifier. And this process also used to reduce mis-classification error. [10]

Amol Prataprao Bhatkar, Dr. G.U.Kharat, proposed detection of Diabetic Retinopathy using Multi Layer Perception Neural Network (MLPNN) classifier. With 64-point Discrete Cosine Transform (DCT) and also with different 09 statistical parameters namely Entropy, mean, standard deviation, average, Euler number, contrast, correlation, energy and homogeneity, a feature vector was formed. To find best feature subset, the Train N Times method was used to train the Multi Layer Perception Neural Network (MLPNN). [11]

Kanika Verma, Prakash Deep and A. G. Ramakrishnan, proposed method of classification based on perimeter of blood vessel, area and hemorrhages produce motivating results. Proposed method used preprocessed retinal images using local, contrast enhancement and adaptive. This proposed metho was used to detect blood vessel, classify different stages of diabetic retinopathy into normal, moderate and non proliferative diabetic retinopathy and identify hemorrhages. The basis of the classification of different stages of DR was the quantification of blood vessels and detection and hemorrhages present in the retinal image. [12]

Lokesh Gowda J, K V Viswanatha, proposed the fuzzy c-means clustering method has been applied to identify the exact region of the diabetic retinopathy after using shape, color and domain knowledge of diabetic retinopathy findings. Then histogram is generated for the normalized color intensities and remove the most of all noise from the given input database images. Then density mapping technique extracts the features. In the segmentation stage, the abnormal area of retinal image was accurately segmented using active contour with fuzzy c-means algorithm. The comparison of proposed diabetic retinopathy detection method was compared with existing techniques in terms of sensitivity, specificity and accuracy. The performance was better than the existing methods. [13]

Vishakha Chandore, Shivam Asati, proposed the dropout layer techniques and trained a deep convolutional neural network model on a large dataset consisting around 35,000 images was used to achieve higher accuracy. When the level of layers stacked more, to process the high-resolution images the network architecture was computation-intensive and complex requiring high level graphics processing unit. Also will try to implement the whole model as an application on mobile phones, so as to make diabetic retinopathy detection easier and time saving. [14]

Ricky Parmar, Ramanathan Lakshmanan, proposed the NVIDIA CUDA Deep neural network library (cuDNN) is a graphics processing unit's accelerated library of primitives for deep neural networks. Convolutional neural networks for prediction model were used and train the model on graphics processing units (GPU). An effective technique for the identification and division of the exudates as well as microaneurysms from the retinal pictures, which plays a critical part in the finding of diabetic retinopathy. A novel method which consequently distinguishes the exudates and microaneurysms from the DR patient's retinal pictures was used for examined and exhibited purpose. [15]

2.2 Research Methodology

Computational Intelligence techniques include the following will established techniques.

Statistics, Image processing, Learning Machines such as neural network, Transformed domain techniques such as FFT, DCT, and WHT etc.

For choice of suitable classifier following configuration will be investigated. Multilayer perceptron Neural network, Support vector machine, Generalized Feed Forward Neural Network, etc.

For each of the architecture, following parameters are verified until the best performance is obtained. Train-CV-Test data, retraining at least five times with different random initialization of the connection, weights in every training run, number of hidden layers, number of processing elements of neurons in each hidden layer.

Possibility different learning algorithms such as Standard Back-Propagation, Conjugate, gradient algorithm, Quick propagation algorithm, Delta Bar Delta algorithm, Momentum

Momentum

Momentum simply adds a fraction m of the previous weight update to the current one. The momentum parameter is used to prevent the system from converging to a local minimum or saddle point. A high momentum parameter can also help to increase the speed of convergence of the system. However, setting the momentum parameter too high can create a risk of overshooting the minimum, which can cause the system to become unstable. A momentum coefficient that is too low cannot reliably avoid local minima, and can also slow down the training of the system.

Conjugate Gradient

CG is the most popular iterative method for solving large systems of linear equations. CG is effective for systems of the form

$$A=xb-A$$

Where x _is an unknown vector, b is a known vector, and A _is a known, square, symmetric, positive-definite (or positive-indefinite) matrix. These systems arise in many important settings, such as finite difference and finite element methods for solving partial differential equations, structural analysis, circuit analysis, and math homework.

Quick propagation

Quick propagation (Quickprop) is one of the most effective and widely used adaptive learning rules. There is only one global parameter making a significant contribution to the result, the e-parameter. Quick-propagation uses a set of heuristics to optimize Back-propagation; the condition where e is used is when the sign for the current slope and previous slope for the weight is the same.

Delta bar Delta

The Delta-Bar-Delta (DBD) attempts to increase the speed of convergence by applying heuristics based upon the previous values of the gradients for inferring the curvature of the local error surface. The delta bar delta paradigm uses a learning method where each weight has its own self-adapting coefficient. It also does not use the momentum factor of the back propagation networks. The remaining operations of the network, such as feed forward recall, are same to the normal back-propagation networks. Delta-Bar-Delta is a heuristic approach in training neural networks, because the past error values can be used to infer future calculated error values.

After regions training & retraining of the classifier, it is cross validated & tested on the basis of the following performance matrix.

Mean Square Error, Normalized Mean Square Error, Classification accuracy

In order to carry out the proposed research work, Platforms/Software's such as Mat lab, Neuro solutions, Microsoft Excel will be used.

2.3 Research Objective

1) To maintain the correctness & accuracy in the diagnosis of retinal abnormalities even though the input images are contaminated by known or unknown noise.
2) To increase the classification accuracy for the diagnosis of retinal abnormalities.

3. CONCLUSION

Use of the proposed optimal classifier based on Computational Intelligence techniques will be result in more accurate and reliable diagnosis of Diabetic Retinopathy. Using our system, ophthalmologist can diagnosed Diabetic Retinopathy with enough confidence. Moreover, our system can also be used by the experts in order to confirm their diagnostic decision.

ACKNOWLEDGEMENT

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