"Automated Detection of non-proliferative Diabetic retinopathy and proliferative Diabetic retinopathy Using efficientnet-B5 CNN model and CLAHE method of Machine Learning"

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Abstract— In this progressive world now day's diabetes has become a common disease that is affecting most of the world population. With diabetes many medical conditions are getting encountered that includes diabetic retinopathy which is mainly concerned with damage to retina that can cause vision loss. Detection of such diabetic eye in modern world can be achieved with help of machine learning techniques that include neural network, computer aided programs. In such systems fundus images are provided to the neural deep learning algorithms to extract features in the fundus images and then calculate the diabetic eye condition. Such mechanism helps us detect the conditions in fundus image more accurately and efficiently.

I. INTRODUCTION

Diabetic Retinopathy (DR) is one of the diabetic diseases that involves early detection which is sometimes not achieved by human computation in that case there needs to be a system that can automatically check for fewer symptoms and guide us with DR to the patients. Hence this will help patients with early treatment .So development needs to be done in machine learning which can take help of different algorithms for easy and accurate computation of diseases.

Development of an automated self-learning system that can early detect non-proliferative Diabetic retinopathy NPDR or proliferative Diabetic retinopathy PDR in an efficient manner without any human intervention. Detection of DR is a critical process that occurs in diabetic patients which remains undetected and can cause severe problems. Hence to overcome that and detect it in early phase we need such kind of system that can help us with accurate detection. This will be achieved by EfficientNetB5 CNN model and classifier techniques.

Traditional screening methods involve manual examination by ophthalmologists using fundus photography and optical coherence tomography (OCT). However, these methods are time-consuming, prone to human error, and require expert knowledge. To address these limitations, deep learning-based automated detection systems have emerged as a promising alternative.

Deep learning models, particularly Convolutional Neural Networks (CNNs), have demonstrated remarkable performance in image classification, feature extraction, and disease prediction. By leveraging large datasets of labeled fundus images, CNNs can learn to distinguish between normal and abnormal retinal structures, enabling **early**-stage DR detection with high accuracy. This research aims to develop an automated self-learning system utilizing the EfficientNet-B5 CNN model to enhance DR diagnosis accuracy, efficiency, and scalability.

II. LITERATURE REVIEW

Detection of Diabetic Retinopathy (DR) is mainly concerned with detection of early damage caused by diabetes to the eye of the patient that can be achieved by help of machine learning techniques that are using mathematical computation and extraction techniques to classify the input retina optical coherence tomography(OCT) into specific conditions to determine stages of Diabetic Retinopathy(DR). Early stage non-proliferative Diabetic retinopathy (NPDR) or proliferative Diabetic retinopathy (PDR) makes use of convolutional neural network (CNN)[1] to extract features from the fundus images. It uses support vector method (SVM) as classifier. Many CNN are trained on basis of divisons[2] that are nothing but predefined datasets that are to be used to detect features of DR.

Random forest, k-neighbor classifier, denseforest[3] are some of the techniques that are recently used for diabetic eye condition. These different classifiers are ensemble into a machine learning system to classify features extracted by neural networks. Fundus images are the images of eye taken from different perspectives that play an important role to help system detect Diabetic eye diseases (DED)[4].Different perspectives are predefined into this system for detecting DED and based on that conditions only DED are predicted. Many researchers have created systems that detect diabetic eye but very few focus on how severe the disease is or at what stage the disease is. This research has created a matrix[5] of the findings of the eye images and classified it on basis of five different categories.Microaneurysms[6] are nothing but small blood clots that occur in diabetic fundus images of eye. Feature-set tuning is one of the technique that uses genetic programming[6] and set of 28 Features to classify the fundus images. Genetic programming mainly involves mathematical expression calculation which helps us achieve accuracy in feature extraction and evaluation. Diabetic eye detection and feature extraction is one of the key point in simultaneous diagnosis of Diabetic eye diseases through deep learning[7]. It includes hierarchical multi-task neural network[7] to do two different tasks like feature extraction and detection differently.

Creating and 3D Multi-path Convolutional Neural Network Based[8] in an system is indeed helpful for detection of Diabetic Retinopathy(DR) through computer aided systems. It includes consideration and segmentation of fundus images to have deeper understanding and detection of DR.Microaneurysms detection with lesion algorithm[9] of neural network in detection of non-proliferative Diabetic retinopathy NPDR helps achieve accuracy and consistency. Adaptive Histogram Equalization with preprocessing technique like CLAHE method[10] helps us get a amplified view of blood vessels that are to be used for feature extraction and detection of diabetic eye diseases. Thus making it more easier to function for neural networks.

Diabetic Retinopathy (DR) detection has improved significantly with the use of artificial intelligence (AI) and deep learning. Researchers have used machine learning techniques such as Convolutional Neural Networks (CNNs), Support Vector Machines (SVMs), and Random Forest classifiers to analyze fundus images and detect DR. However, many of these models still face challenges in terms of accuracy, efficiency, and generalization

III. Methodology/Planning of work/Proposed Work

3.1 Methods of research

1) Convolutional Neural Network (CNN) :- CNN is nothing but a neural network type that mainly works in area of image classification and feature extraction. It consists of multi-layer perceptron that means that each neuron in earlier layer is connected to each neuron on next level. Pooling is a technique used in CNN to combine clusters.

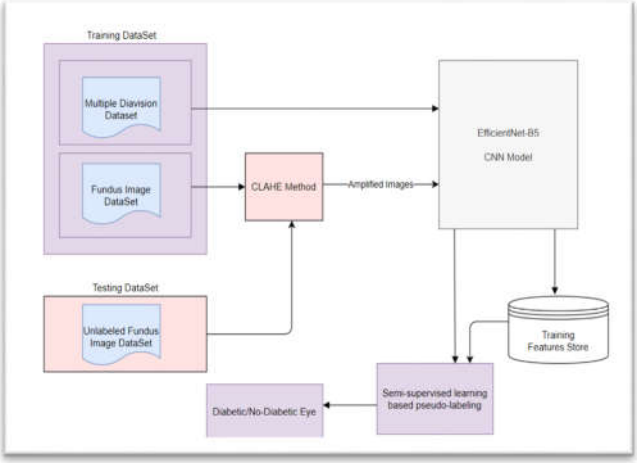
2) EfficientNet-B5 CNN model:- EfficientNet are models that are used for feature extraction and

classification using ImageNet that is nothing but a image database that are segmented to obtain a 3D view of an image and characterize it into category . It is improved network creation with maximum accuracy.

3) Classifier techniques of Machine learning:-A semi-supervised pseudo labeling technique known for training itself on small set of labeled data provided to it which in return will classify the unlabeled dataset provided to it in accordance to its previous pre-learned labels. In short it helps us with labeling the dataset on its previous dataset on which it was trained.

4) CLAHE Method:- It is preprocessing technique to amplify the image being given to it as input.

4.2. Proposed System



Our proposed system mainly concentrates on training of EfficientNet-B5 CNN model on basis of the preprocessed data that is being provided to it in form of fundus images that are amplified with help of CLAHE method. Further the features extracted are provided to classifiers for the classification of different feature according to the similarity and labeling and stored into database. Following are the modules that will be implemented in the system.

1. Diavision creation:
   Diavision creation mainly involves analysis and listing of different features that are mainly encountered in fundus images regarding the Diabetic eye diseases. They are written in a programmatic way that is readable to computerized system for automatic analysis.
2. Pre-Processing CLAHE method:
   Preprocessing phase uses CLAHE method which involves amplification of each and every section of fundus image that is provided to it. It gives us a clarified view of each and every nerve in that image.
3. Semi-Regulated network creation and feature extraction:
   This module involves training of EfficientNet-B5 CNN model on basis of the preprocessed data that is being provided to it in form of fundus images that are amplified with help of CLAHE method. EfficientNet-B5 CNN performs feature extraction and segmentation of the images and provides a 3D view of images with its features.
4. Classifier Implementation using pseudo-labeling:
   Pseudo labeling is done by training the pseudo classifier onto a predefined set of labels that we encounter while differentiating the diabetic eye diseases. Once the pseudo classifier trains itself it is capable of labeling and classifying the data input that it receives from EfficientNet-B5 model. Hence the classifier labels the fundus images into labeled clusters.
5. Result analysis and evaluation:
   Result analysis and evaluation includes calculation of precision, recall, F-measure and accuracy.

CONCLUSION

Detection of NPDR, PDR and normal eye will be achieved with more accuracy and efficiency. This system will be able to calculate the results in short span of time with self training itself to achieve better performance. Hence a new system with better precision value and accuracy will be obtained that can detect early diabetic eye disease.

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