DISCOVERY OF DIABETIC RETINOPATHY

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Abstract:

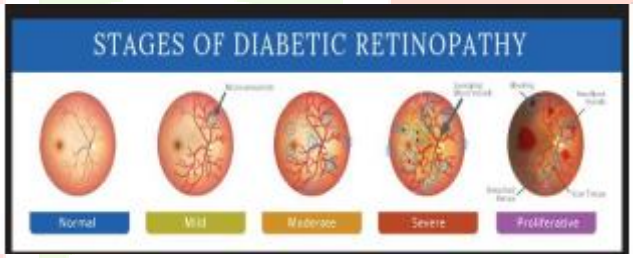
The datasets that are taken into consideration are Diabetic Retinopathy detection 2015 and Aptos 2017 blindness detection which are both obtained from Kaggle. According to International Diabetics Federation (IDF) Diabetics Atlas 2017, around 463 million people are affected by diabetes.

IndexTerms - Diabetic Retinopathy (DR), Convolutional Neural Network(CNN), Deep Learning, ResNet-50, Fundus images, Classification, Pre-processing.

INTRODUCTION

According to International Diabetics Federation (IDF) Diabetics Atlas 2017, around 463 million people are affected by diabetes. As of 2017, it was reported 425 million. The IDF expects the number to rise to 595 million by 2035 when one in every 10 people will have the disease. Approximately 80% of the people living with diabetes are in low- and middle-income countries. disorders, diabetic retinopathy, etc.

Diabetic Retinopathy is a crucial eye condition that results in 1 loss of vision that cannot be reversed or corrected once experienced. No matter whether a person is type 1 or type 2 diabetic, the probability of the disease increases with age. The diagnosis of DR mostly depends on the observation and evaluation of fundus photographs which can be time-consuming even for experienced experts. Therefore, computer aided diagnosis approaches, which can accurately detect DR in a short time, have great potential in clinical analysis to improve the screening rate of DR and reduce the number of DR cases.



prompted researchers towards deep learning. Further research in medical fields paved the path for many computer-aided technologies like data mining, image processing, machine learning, and deep learning. CNN in deep learning tends to provide constructive results when it comes to the job of image classification. CNN variant, Residual Network (ResNet) is a deep learning model used for computer vision applications, designed to support hundreds or thousands of convolutional layers, for the classification of fundus (eye) images based on the severity level.

RELATED WORK

[1] have proposed a system for Diabetic Retinopathy detection based on the presence of the feature that shows the symptoms of the disease. The system makes use of fundus images, the bright lesions on the retina, and the exudates extracted as they indicate the symptoms of the disease. Based on the features extracted various stages of the disease are detected using hierarchical classification. They have emphasized the need for a detection system due to the increased number of cases and fewer ophthalmologists to treat, and the system has resulted in high accuracy in sensitivity and specificity. Imran Qureshi et al.,

[2] They have also discussed all the CAD systems which have been developed for various needs such as computation Intelligence and Image processing techniques. They also conducted a survey on screening algorithms various research papers in detection and their challenges and results.

[3] in their work used a two-staged method for Diabetic retinopathy detection: LBP (Local Binary Patterns) for feature extraction and Machine Learning specifically Support Vector Machine(SVM) and Random Forest for classification purposes. The results obtained by the random forest outperformed the SVM with an accuracy of 97.46%.

[4] As a result, 97.3 % validation accuracy was achieved and the proposed hierarchical pruning can be employed to simplify other CNN structures as well. Jiaxi Gao et al.,

[5] their work proposed a deep-learning approach for DR disease classification. After some pre-processing, computationally efficient CNN models were used to classify the disease in image dataset with 83% validation accuracy. I.Sadek et al.,

[6] This method outperforms the Bag of words approach and achieved an accuracy of 91%-92%. Tiken Mirangthem Singh et al.,

[7] in their work they used CNN to classify fundus retinal images and accurately categorize them into five stages of the disease. As a result of their experiment, 71% validation accuracy was achieved M.Voets et al.,

[8] However, this study is the re-implementation of already existing work but on different data sets which provided 95% of AUC. The difference in AUC between the original and the re-implemented method tends to be very large. Carson Lam, Darvin Yi, et al.,

[9] In this paper, we demonstrate the use of convolutional neural networks (CNNs) on color fundus images for the recognition task of diabetic retinopathy staging. Our network models achieved test metric performance comparable to baseline literature results, with a validation sensitivity of 95%. R. Raja Kumar, R. Pandian, et al.,

[10] This method gives higher accuracy (94.44%) with reduced hardware requirement than conventional approaches to detect and classify DR into five stages, namely no DR, mild, moderate, severe, and proliferative DR. Mounia Mikram, Chouaib Moujahdi, et al.,

[11] These studied models perform two main tasks: deep feature extraction and then the classification of diabetic retinopathy according to its severity. The models were trained and validated on a publicly available dataset of 80,000 images and they achieved an accuracy of 80.7%. Chandra Satapathya, Steven Lawrence, et al.,

[12] In this paper, we propose a transfer learning-based CNN architecture on color fundus photography that performs relatively well on a much smaller dataset of skewed classes of 3050 training.

[13] Pre-trained architectures such as VGG16, EfficientNetB5, and ResNet50 provide 76.47%, 90.2%, and 97.2% accuracies on the kaggle (APTOS) data set. Sabiha Gungor Kobat,Nursena Baygin et al.,

[14] Two datasets are used to test the model: a newly collected three-class dataset comprising 2355 DR images and the established openaccess five-class Asia Pacific Tele-Ophthalmology Society (APTOS) 2017 dataset comprising 3662 images.

[15] The proposed DR detection system requires an automatic segmentation of the ETDRS 7SF to remove undesirable components such as eyelashes and skin. Using the segmented ROI image, they have employed the deep learning architecture, the residual network with 34-layer (ResNet-34) model21 as a classifier for the DR detection task. The 90% and 10% of images in the training set are utilized for training and validation tasks. From ten runs of ten-fold stratified cross-validation tests with a single run of ten-fold validation, DR detection system based on the ETDRS 7SF images extracted from the UWF photography achieved a

sensitivity of 83.38±0.48%, a specificity of 83.41±0.42%, an accuracy of 83.38±0.47%, and an AUC of 91.50±0.48%.

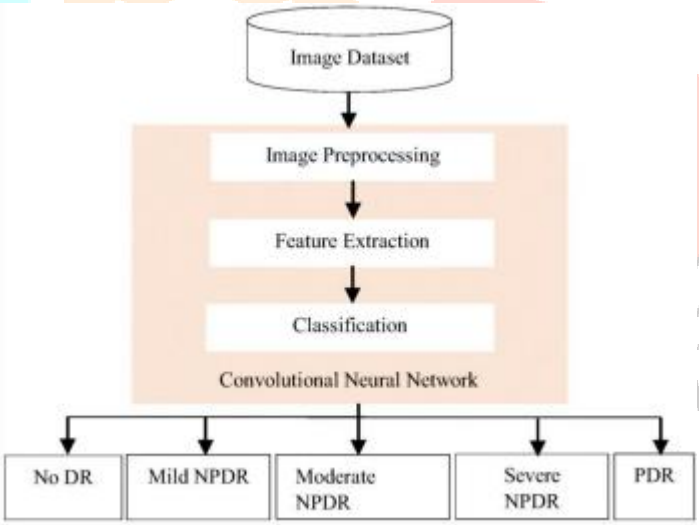
[16] This study aims to systematically find and analyze high-quality research work for the diagnosis of DR using deep learning approaches. This research comprehends the DR grading, and staging protocols and also presents the DR taxonomy. It identifies, compares, and investigates the deep learning-based algorithms, techniques, and, methods for classifying DR stages. This study shows that in the last few years there has been an increasing inclination towards deep learning approaches. 35% of the studies have used Convolutional Neural Networks (CNNs), 26% implemented the Ensemble CNN (ECNN) and, 13% of Deep Neural Networks (DNN) are among the most used algorithms for DR classification. Zehao Yu, Xi Yang, Gianna L. Sweeting et al

OBJECTIVES

♣ To implement a Computer-aided diagnosis system that can help alleviate the burden on ophthalmologists by automatically detecting DR on retinal images. ♣ To identify systemic risk factors, like having diabetes for a long time, poor control of your blood sugar level, High blood pressure, and High cholesterol.

METHODOLOGY

In order to assess the strengths and limitations of CNNs, several architectures were trained and tested with particular focus on a 50 layers deep model called ResNet50.



CNN

A Convolutional Neural Network (CNN) architecture usually consists of convolutional layers, pooling layers or subsampling layers, fully connected layers and the classification layer. CNN is the most widely used neural network for identifying the existence of Diabetic Retinopathy (DR) and classifying its severity in a fundoscopy. The primary task is to select an appropriate CNN architecture and fine-tuning its parameters to achieve optimal results. We decided to experiment with Resnet 50 model (pre-trained network). With the help of keras framework, running on top of a TensorFlow backend, the necessary Resnet50 architecture was implemented.

ResNet50

In ResNet the residual block was used successfully trained 152 layers with an error rate of 4.49% for a single model on the ImageNet validation set, and 3.57% error on the test validation set. It is one of the most powerful deep neural networks. There are many variants of ResNet architecture available some of them are ResNet18, ResNet-34, ResNet-50, ResNet-101, and ResNet-110. In our work to detect Diabetic retinopathy (DR), we are going to use ResNet-50 which is one of the most vibrant networks on its own.

DATASET

It was designed to image the inside of the eye primarily the retina, optic disc, macula and posterior pole.

The present works consists of the DR classification using the Diabetic Retinopathy Detection 2015 challenge dataset available in (Diabetic Retinopathy 2015 Data Colored Resized | Kaggle) Retinal images were provided by EyePACS, a free retinopathy screening platform. A left and right field is provided for each subject. Images are tagged with a subject id as well as either left or right (i.e 1_left.png is the left eye of patient id 1). The dataset consists of 35126 retinal images to detect diabetic retinopathy and all images are resized into 224x224 pixels. A clinician-rated the presence of diabetic retinopathy in each image on a scale of 0 to 4, according to the scale mentioned previously. The number of images for each stage of infection is presented in table below :

Class	Stage	Number of Images	Size in percentage
0	Normal eyes	25810	73%
1	Mild DR	2443	7%
2	Moderate DR	5292	15%
3	Severe DR	873	2%
4	Proliferative DR	708	2%

CONCLUSION

With the aid of transfer learning, performance on the task of classifying diabetic retinopathy is evaluated using a variety of performance indicators. The Resnet50 V2 is the subject of the study. The investigation of architectural performance shows that Transfer Learning on the ResNet50 V2 architecture, has an accuracy of 93%. We can assert that increasing the number of trainable layers in the ResNet50 model will improve performance since they support the maintenance of a low error rate far further into the network. By enabling this additional short-cut conduit for the gradient to flow through, ResNet's skip connections address the issue of disappearing gradients in deep neural networks. The suggested method seeks to improve the resnet50 model in order to classify retinal fundus images more accurately and achieve higher accuracy rates.

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