Deep Learning Fundus Image Analysis for Early Detection of Diabetic Retinopathy

Introduction

Diabetic Retinopathy (DB) is a complication of diabetes that affects the eyes. It is usually caused by damage of blood vessels in the tissue at retina (back layer of the eye). Early symptoms may include blurriness, floaters, dark or empty areas in vision and difficulty perceiving colour blindness. It requires constant monitoring and if complications develop, it can reduce life expectancy. It can cause blindness if it is not diagnosed and untreated. Still now there is no cure for the medical medication. While the treatment can stop or slow down the progression of Diabetic Retinopathy. Mild cases may be carefully treated with diabetes management.

Literature Survey

[1] The proposed method uses Alex net Convolutional Neural Network (CNN) to detect the diabetes on a fundus image. The dataset used was from the MESSIDOR database and it contains 1200 fundus images and they were filtered for the project into 580 images of normal and exudates images. On the CNN process the dataset has been divided into two which is training and testing dataset. This method gives more than 90% accuracy on 50% of the training dataset and the remaining 50% dataset is used for testing purpose. The testing gives about 85% accuracy.

Advantages: The detection of diabetic retinopathy has good accuracy and the CNN have been used to detect it (which is a widely used method in medical image analysis and classification).

Limitations: The dataset was insufficient to train the neural network and only 580 images were used for both training and testing even though they received a good accuracy. It also found it difficult to detect smaller exudates on the image.

[2] The Proposed system developed a CNN architecture to classify the diabetic retinopathy as 5 classes namely No DR, Mild DR , Moderate DR, Severe DR, Proliferative DR respectively in the fundus imagery. They have analysed the past works done using CNN to detect DR and they have corrected the networks in CNN to make it more accurate and efficient. On the dataset containing 80000 images they have achieved an accuracy of 75%.

Advantages: A larger dataset has been used to train the CNN and overfitting issue is solved. They have used a 5-class problem to classify DR. Healthy eye have been detected correctly.

Limitations: There is some issues in classification to distinguish between the mild, moderate and severe cases of DR.

[3] They have used a Deep Convolutional Neural Network (DCNN) to analyse the fundus image and predict the stage such as No DR, Moderate DR (a combination of mild and moderate Non-Proliferative DR), Severe DR (severe NPDR, and Proliferative DR). They have almost used 3468 fundus images taken in multiple clinics available in Kaggle over a period of time. They have a achieved an accuracy of more than 80 percent.

Advantages: It has achieved a competitive accuracy, sensitivity and specificity when compared to other CNN based techniques.

Disadvantages: Overfitting issue arises when the model is trained with limited dataset and fails when applied on a new dataset.

[4] The proposed model is based on the DenseNet121 architecture. A speciality about this is, each output of a convolution layer (feature map) is concatenated with the subsequent layers of the same block. It classifies DR as 5 classes based on the level of DR which comprises of No DR, Slight DR, Medium DR, Severe DR and PDR. The proposed method has used 2 datasets (Messidor and APTOS) by a cross-testing approach so that the model can acquire the complex features.

Advantages: The model was designed to detect DR at early stages.

Limitations: As they have used cross-testing approach with unbalanced data the accuracy is low compared to the state of art methods. Also, the model had difficulty to classify the Slight NDPR class.

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