Deep Learning Fundus Image Analysis For Early Detection Of Diabetic Retinopathy

Introduction

Approximately four hundred and twenty million people worldwide have been diagnosed with diabetes mellitus. The prevalence of this disease has doubled in the past 30 years and is only expected to increase, particularly in Asia. Of those with diabetes approximately one-third are expected to be diagnosed with diabetic retinopathy (DR), a chronic eye disease that can progress to irreversible vision loss. Early detection which is critical for good prognosis, release on skilled readers and is both labour and time-intensive. Automated techniques for diabetic retinopathy diagnoses are essential to solving these problems.

Literature Review

1.Development and Validation of a Deep Learning Algorithm for Detection of Diabetic Retinopathy in Retinal Fundus Photographs (2016)

- The reference standard used for this study was the majority decision of all ophthalmologist graders.
- This means the algorithm may not perform as well for images with subtle findings that a majority of ophthalmologist would not identified.
- Another fundamental limitation arises from the nature of deep networks, in which the neural network was provided with only the image and associated grade, without explicit definitions of features.

2. Development and Validation of a Deep Learning Algorithm for Detection of Diabetic Retinopathy in Retinal Fundus Photographs (2018)

- The original study used non-public fundus images from EyePACS and three hospitals in India for training. This Study used a different Eyepatch data set from Kaggle.

- The original study used the bench mark data set Messidor-2 to evaluate the algorithm's performance. This study used the same data set. In the original study, ophthalmologist regraded all images for diabetic retinopathy, macular edema, and image gradeability.
- There was one diabetic retinopathy grade per image for data set, and assessed image gradability ourselves.
- The original study did not provide hyper-parameter settings. But some of these were later published.

3.Transfer Learning based Detection of Diabetic Retinopathy from small Dataset (2019)

- Transfer learning from an already trained deep convolutional network can be used to reduce the cost of training from scratch and to train with small training data for deep learning.
- In this work, they used a pretrained Inception-V3 model to take advantage of its Inception modules for Diabetic Retinopathy detection.
- In order to tackle the labelled data insufficiency problem, they sub-sampled a smaller version of the Kaggle Diabetic Retinopathy classification challenge dataset for model training, and tested the model's accuracy on a previously unseen data subset. Their technique could be used in other deep learning based medical image classification problems facing the labelled training data insufficiency.

4.Deep Learning Approach to Diabetic Retinopathy Detection (2020)

- One of the essential challenges is early detection, which is very important for treatment success.
- In this paper, they proposed an automatic deep-learning-based method for stage detection of diabetic retinopathy by single photography of the human fundus. Additionally, they propose the multistage approach to transfer learning, which makes use of similar datasets with different labelling.
- The presented method can be used as a screening method for early detection of diabetic retinopathy with sensitivity and specificity of 0.99 and is ranked 54 of 2943 competing methods (quadratic weighted kappa score of 0.925466) on APTOS 2019 Blindness Detection Dataset (13,000 images).

5.Diabetic Retinopathy Detection and Retinal Image Generation (2021)

- To visualize the symptom encoded in the descriptor, they propose Patho-GAN, a new network to synthesize medically plausible retinal images.
- By manipulating this descriptors, they could even arbitrarily control the position, quantity, and categories of generated lesions. They also show that their synthesized images carry the symptoms directly related to diabetic retinopathy diagnosis. Their generated images are both qualitatively and quantitatively superior to the ones by previous methods.
- Besides, compared to existing methods that take hours to generate an image, their second level speed endows the potential to be an effective solution for data augmentation.

References:

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