Literature Survey

Deep Learning Fundus Image Analysis for Early Detection of Diabetic Retinopathy

1. Deep Learning Fundus Image Analysis for Diabetic Retinopathy and Macular Edema Grading

Abstract:

Diabetes is a globally prevalent disease that can cause visible microvascular complications such as diabetic retinopathy and macular edema in the human eye retina, the images of which are today used for manual disease screening and diagnosis. This labour-intensive task could greatly benefit from automatic detection using deep learning technique. Here we present a deep learning system that identifies referable diabetic retinopathy comparably or better than presented in the previous studies, although we use only a small fraction of images (<1/4) in training but are aided with higher image resolutions. We also provide novel results for five different screening and clinical grading systems for diabetic retinopathy and macular edema classification, including state-of-the-art results for accurately classifying images according to clinical five-grade diabetic retinopathy and for the first time for the four-grade diabetic macular edema scales. These results suggest, that a deep learning system could increase the cost-effectiveness of screening and diagnosis, while attaining higher than recommended performance, and that the system could be applied in clinical examinations requiring finer grading.

Reference: Sahlsten, J., Jaskari, J., Kivinen, J., Turunen, L., Jaanio, E., Hietala, K., & Kaski, K. (2019). Deep learning fundus image analysis for diabetic retinopathy and macular edema grading. *Scientific reports*, *9*(1), 1-11.

1. Early Detection of Diabetic Retinopathy by Using Deep Learning Neural Network

Abstract:

This project presents a method to detect diabetic retinopathy on the fundus images by using deep learning neural network. Alexnet Convolution Neural Network (CNN) has been used in the project to ease the process of neural learning. The data set used were retrieved from MESSIDOR database and it contains 1200 pieces of fundus images. The images were filtered based on the project needed. There were 580 pieces of images types .tif has been used after filtered and those pictures were divided into 2, which is Exudates images and Normal images. On the training and testing session, the 580 mixed of exudates and normal fundus images were divided into 2 sets which is training set and testing set. The result of the training and testing set were merged into a confusion matrix. The result for this project shows that the accuracy of the CNN for training and testing set was 99.3% and 88.3% respectively.

Reference: Johari, M. H., Hassan, H. A., Yassin, A. I. M., Tahir, N. M., Zabidi, A., & Rizman, Z. I. & Wahab, NA (2018). Early detection of diabetic retinopathy by using deep learning neural network. *International Journal of Engineering and Technology (UAE)*, *7*(4), 198-201.

1. Deep learning for diabetic retinopathy detection and classification based on fundus images: A review

Abstract:

Diabetic Retinopathy is a retina disease caused by diabetes mellitus and it is the leading cause of blindness globally. Early detection and treatment are necessary in order to delay or avoid vision deterioration and vision loss. To that end, many artificial-intelligence-powered methods have been proposed by the research community for the detection and classification of diabetic retinopathy on fundus retina images. This review article provides a thorough analysis of the use of deep learning methods at the various steps of the diabetic retinopathy detection pipeline based on fundus images. We discuss several aspects of that pipeline, ranging from the datasets that are widely used by the research community, the pre-processing techniques employed and how these accelerate and improve the models' performance, to the development of such deep learning models for the diagnosis and grading of the disease as well as the localization of the disease's lesions. We also discuss certain models that have been applied in real clinical settings. Finally, we conclude with some important insights and provide future research directions.

Reference: Tsiknakis, N., Theodoropoulos, D., Manikis, G., Ktistakis, E., Boutsora, O., Berto, A., ... & Marias, K. (2021). Deep learning for diabetic retinopathy detection and classification based on fundus images: A review. *Computers in Biology and Medicine*, *135*, 104599.

1. Detection of diabetic retinopathy using deep learning methodology

Abstract:

Diabetic retinopathy is a complication of diabetes that targets the eyes by damaging the retinal blood vessels. Initially it is asymptomatic or causes fluctuating vision problems. As it becomes severe, it affects both the eyes and eventually causes partial or complete vision loss. Primarily occurs when the blood sugar level is unmanageable. Therefore, the person with diabetes mellitus is always at a high risk of acquiring this disease. The early detection can deter the contingency of complete and permanent blindness. Thus, requires an efficient screening system. The present work considers a deep learning methodology specifically a Densely Connected Convolutional Network DenseNet-169, which is applied for the early detection of diabetic retinopathy. It classifies the fundus images based on its severity levels as No DR, Mild, Moderate, Severe and Proliferative DR. The datasets that are taken into consideration are Diabetic Retinopathy Detection 2015 and Aptos 2019 Blindness Detection which are both obtained from Kaggle. The proposed method is accomplished through various steps: Data Collection, Pre-processing, Augmentation and modelling. Our proposed model achieved 90% of accuracy. The Regression model was also employed, manifested up an accuracy of 78%. The main aim of this work is to develop a robust system for detecting DR automatically.

Reference: Mushtaq, G., & Siddiqui, F. (2021, February). Detection of diabetic retinopathy using deep learning methodology. In *IOP Conference Series: Materials Science and Engineering* (Vol. 1070, No. 1, p. 012049). IOP Publishing.

1. Deep Learning Techniques for Diabetic Retinopathy Classification: A Survey

Abstract:

Diabetic Retinopathy (DR) is a degenerative disease that impacts the eyes and is a consequence of Diabetes mellitus, where high blood glucose levels induce lesions on the eye retina. Diabetic Retinopathy is regarded as the leading cause of blindness for diabetic patients, especially the working-age population in developing nations. Treatment involves sustaining the patient’s current grade of vision since the disease is irreversible. Early detection of Diabetic Retinopathy is crucial in order to sustain the patient’s vision effectively. The main issue involved with DR detection is that the manual diagnosis process is very time, money, and effort consuming and involves an ophthalmologist’s examination of eye retinal fundus images. The latter also proves to be more difficult, particularly in the early stages of the disease when disease features are less prominent in the images. Machine learning-based medical image analysis has proven competency in assessing retinal fundus images, and the utilization of deep learning algorithms has aided the early diagnosis of Diabetic Retinopathy (DR). This paper reviews and analyses state-of-the-art deep learning methods in supervised, self-supervised, and Vision Transformer setups, proposing retinal fundus image classification and detection. For instance, referable, non-referable, and proliferative classifications of Diabetic Retinopathy are reviewed and summarized. Moreover, the paper discusses the available retinal fundus datasets for Diabetic Retinopathy that are used for tasks such as detection, classification, and segmentation. The paper also assesses research gaps in the area of DR detection/classification and addresses various challenges that need further study and investigation.

Reference: M. Z. Atwany, A. H. Sahyoun and M. Yaqub, "Deep Learning Techniques for Diabetic Retinopathy Classification: A Survey," in IEEE Access, vol. 10, pp. 28642-28655, 2022, doi: 10.1109/ACCESS.2022.3157632.