

Analysis & optimization of deep neural networks for screening and severity grading of diabetic retinopathy using retinal images



Jharna Majumdar^{1,2} and Ankit Kumar²

¹Head Centre for Robotics research, Head Centre for Space Research, India

²Meenakshi Institute of Technology, India

Abstract

The changes in lifestyles of people and the lack of focus and care on the health issues have led to a rise in the number of diabetic patients.

Diabetic Retinopathy is a complication of diabetes which is determined by the damaging of blood vessels in eye. It is the leading cause of vision impairment that can lead to blindness. For detection and grading, retinal image has to be operated on to see the symptoms of the disease and its complexity. With the advancement in technologies, availability of high-end Computing System, availability of large amount of data and new methodologies to process the data, we can overcome the problem we faced before and create awareness among the individuals.

In the proposed work, we have built a two-stage Detection and grading system using Deep Neural Network model and compared the efficiencies of Convolutional Neural Network. For our analysis, we have made use of the publicly available dataset. The pictures are divided into 5 classes as per severity levels and the number of images in the classes was unbalanced. Having a large number of such images and we have decided to use Deep neural networks for classification because of the limitation of conventional machine learning techniques to operate with very huge amount of Pictorial data. After pre-processing the dataset, we have performed hyper parametric optimisation in the stock neural networks architecture for increasing the prediction accuracy which has come to be 98 % accuracy. After testing on the stock network architectures with different activation functions, number of epochs, kernel sizes, we have also introduced an optimised custom neural network for DR screening-grading system which has come to an accuracy of 91%.

On performing these hyper-parametric variations in the architecture, the approach was to classify if the retinal image is a Diabetic Retinal Image or not. i.e. Screening stage. And then classifying the different stages of Diabetic Retinopathy .i.e. Grading stage. This approach resulted in an accurate custom model which is capable of image classification based on Disease pathologies from its four severity levels. i.e. NPDR (mild, moderate, severe) and PDR. NPDR stands for non-proliferative diabetic retinopathy which is considered an early stage and spreads further into advanced stage. PDR stands for proliferative diabetic retinopathy, which is a sever stage and may result for permanent vision loss or surgery. The custom built prediction system was screening with an accuracy which can be implemented in real-time use.

The proposed research work also leads to confidentiality and data privacy challenges as the medical data being examined is to be restricted among the patients and doctors only. The motivation behind this work is to serve mankind and help them to lead a happy and healthy balanced life, emphasizing on the latest technological advancements for deriving accurate conclusions and giving way forward towards prevention and early treatment, managing the cure of complications in Diabetic Healthcare.

Biography

Jharna majumdar is currently the dean R & D, prof. dept of m tech comp sc. & engg. and head, centre for robotics research at the nitte meenakshi institute of technology, India. Majumdar served defence research & development organization, Govt. of India from 1990 to 2007, worked as a research scientist on 'robotics and automation' at the forschungs zentrum informatik, karlsruhe, Germany from 1983 to 1989 and as a research scientist at the stanford research international california, USA in 2002. Majumdar has a Ph.D in electrical engg., undergraduate and post graduate engineering from IIT India. Majumdar published more than 180 reviewed technical papers, has 4 patents and received a large number of awards. Some of her worth mentioning awards are: award from president, Stanford research international (sri international), USA, performance excellence award from the prime minister of India, Dr V M Ghatage award from aeronautical society of India, Dr. suman sharma award from national design and research forum (NDRF), Dr. Kalpana chawla memorial lecture award etc. her current research areas include real time image and video processing, data and video analytics, robotics and autonomous systems, artificial intelligence, machine learning and deep learning.



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