Deep Residual Network based Automatic Image Grading for Diabetic Macular Edema

Poster · April 2018

DOI: 10.13140/RG.2.2.24611.02082/1

1 author:

Kamalakkannan Ravi
University of Central Florida
9 PUBLICATIONS **32** CITATIONS

SEE PROFILE

Deep Residual Network based Automatic Image Grading for Diabetic Macular Edema

Santhosh Kumar Sukumar[1], Kamalakkannan Ravi[1], Supriti Mulay[1], Keerthi Ram[1] and Mohanasankar Sivaprakasam[1,2,*]

***Abstract*— Diabetic Macular Edema (DME) is an advanced symptom of diabetic retinopathy that affects central vision of diabetes patients. An automated system for early detection of DME symptom has been proposed herein to elude vision impairment and assist in effective treatment. Transfer learning based on Deep Residual Networks (ResNets) which has proven to be a very successful model in many image classification applications and is used in the proposed system for automatic grading of DME images. Validation of the developed system on Indian Diabetic Retinopathy Image Dataset (IDRID 2018) results in 86.56 % detection accuracy.**

I. INTRODUCTION

Recent research has given a better understanding of the importance of early diagnosis of diabetic retinopathy [1]. Current evidence reveals that with deep neural networks, series of breakthroughs for image classification are being carried out by naturally integrating low/mid/high level features and classifiers in an end-to-end multilayer fashion, and the "levels" of features are also enriched by the number of stacked layers (depth) [2]. In IDRID 2018 dataset [3], the grading, based on the location of hard exudates, highlights the risk of having Diabetic Macular Edema (DME). Hence, we have formulated the proposed automatic image grading for DME as a problem of detection of hard exudates' location, where the deep features play a vital role in identifying appropriate information on hard exudates leading us to hand-pick ResNets architecture[4].

II. METHODS

Overview of the proposed Deep Residual Network based Automatic Image Grading system for Diabetic Macular Edema has been presented in Fig. 1.

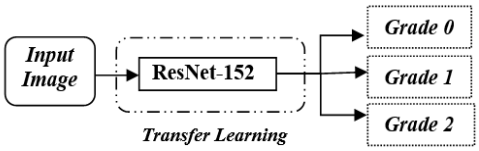

Figure 1. Overview of the proposed system.

IDRID Dataset

IDRID 2018 dataset of DME grading consists of a total of 413 images, which includes 177 Grade-0 images, 41 Grade-1 images and 195 Grade-2 images respectively. Here, '*Grade-0'* refers to no apparent hard exudate(s), '*Grade-1'* refers to the presence of hard exudate(s) outside the radius of one disc diameter from the macula centre and '*Grade-2'* refers to the existence of hard exudate(s) within the radius of one disc diameter from the macula centre. Each input image is of dimension (4288 x 2848).

ResNet-152

During the training phase, (244 x 244) dimension image patch is *randomly cropped* from each image so as to input to the standard ResNet-152 architecture. To train the network, *stochastic gradient descent* (SGD) optimization algorithm is used with learning rate 0.001 and momentum parameter 0.9. Here, the ResNet-152 model is trained for 1000 epochs with *cross entropy* loss. Further, the learning rate is reduced by a factor of 0.1 for every 7 epochs, to assist the performance of the learning phase. During the testing phase, each image is resized to (256 x 256) and subjected to *centre crop* approach in order to obtain (244 x 244) dimension image patch according to the standard ResNet-152 architecture.

III. RESULTS AND DISCUSSION

The proposed system has been subject to five-fold cross validation and the results are shown in Fig. 2. The deviation (± 2.5%) in performance of the system is due to the selection of random crop in the training phase. Further, the proposed system can be fine-tuned with different selection criteria to reduce the probability of cropping dark background regions across frames.

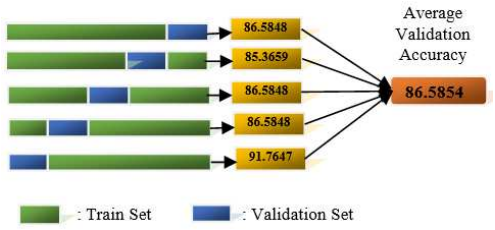

Figure 2. Five-fold Cross Validation Accuracy

REFERENCES

[1] S. Joshi and P.T. Karule, "A review on exudates detection methods for diabetic retinopathy," in *Biomed. & Pharmaco.,* vol. 97, Elsevier, 2018, pp.1454-1460.

[2] G. Litjens et al., "A survey on deep learning in medical image analysis," in Med. Img. anal., vol. 42, Elsevier, 2017, pp.60-88.

[3] https://idrid.grand-challenge.org/data/, accessed on: 16/4/2018.

[4] K .He et al., "Deep residual learning for image recognition," in *Proc. IEEE CVPR*, 2016, pp. 770-778.

[1]Healthcare Technology Innovation Centre, IITM Research Park, Chennai, India. [2]Dept. of Electrical Engineering, Indian Institute of Technology Madras, Chennai, India. *Corresponding author: +91-44-2257-4454; fax: +91-44-2257-4401; e-mail: mohan@ee.iitm.ac.in).

Preprint submitted to 40th Annual International Conference of the IEEE Engineering in Medicine and Biology Society. Received April 20, 2018.