LITERATURE SURVEY ON DEEP LEARNING FUNDUS IMAGE ANALYSIS FOR EARLY DETECTION OF DIABETIC RETINOPATHY

APPLICATION	AUTHOR NAME	YEAR	FEATURES
DEEP LEARNING FUNDUS IMAGE ANALYSIS FOR DIABETIC RETINOPATHY AND MASCULAR EDEMA GRADING	Jaako Sahlsten, Joel Jaskari, Jyri Kivinen, Lauri Turunen	2019	In this study, we have presented a systematiccomputational methodology for diabetic retinopathy and macular edema classification, and assessed its performance on a non-open dataset using five different diabetic retinopathy and macular edema classification systems.We have found that our deep learning model achieved comparable or better results with only a small fraction (< 1/4) of training set images than used recently by two other groups to obtain the state-of-the-art results in the nonreferable/referable diabetic retinopathy (NRDR/RDR) classification, with similar model architecture. The goodness of these results can most likely be attributed on one hand to regularizing image preprocessing and on the other hand to the features in the dataset and in the

			experimental setting. For example, our database was prepared with class/grade-balance in mind, so that its grade-distribution when considering the NRDR/RDR classification, was aimed to be uniform and include as many severe cases as possible, thus having a grade distribution which does not necessarily follow a population or a clinical distribution. We have also investigated the effect of the size of the images used in training, on the performance of the trained deep learning system in the fundus image classification, an assessment which was limited in previous studies to image sizes less than 779 × 779 pixels, thus excluding near native retinal camera resolutions.
AUTOMATED IDENTIFICATION OF DIABETIC RETINOPATGHY USING DEEP LEARNING	Rishab Gargeya , Theodore Leng	2017	The objective of this study was to develop robust diagnostic technology to automate DR screening. Referral of eyes with DR to an ophthalmologist for further evaluation and treatment would aid in reducing the rate of vision loss, enabling timely and accurate diagnoses. We developed and evaluated a data-driven deep learning algorithm as a novel diagnostic tool for automated DR detection. The algorithm processed color fundus

			images and classified them as healthy or having DR, identifying relevant cases for medical referral. We used area under the receiver operating characteristic curve (AUC) as a metric to measure the precision–recall trade-off of our algorithm, reporting associated sensitivity and specificity metrics on the receiver operating characteristic curve. Our model achieved a 0.97 AUC with a 94% and 98% sensitivity and specificity, respectively, on 5-fold cross-validation using our local data set. A fully data-driven artificial intelligence–based grading algorithm can be used to screen fundus photographs obtained from diabetic patients and to identify, with high reliability, which cases should be referred to an ophthalmologist for further evaluation and treatment. The implementation of such an algorithm on a global basis could reduce drastically the rate of vision loss attributed to DR.
MACHINE LEARNING IDENTIFICATION OF DIABETIC RETINOPATHY	Nikita Gurudath, Mehmet Celenk,	2014	First order features provide less than reliable data for Classification of diabetic retinopathy. The fractal features emphasize the severity of the disease. Using a combination of the

			two, a classification accuracy as high as 98.1% is obtained using the SVM. The original color fundus images are smooth in appearance Thus, classification utilizing the features extracted from them directly does not yield high recognition accuracy. Classification using the neural net greatly depends on how well the training steps can map the data from the higher dimensional feature space to the linearly separable classification space. As expected the processing performance depends on the number of neurons in the hidden layer. A major outcome, this research aims to check for consistency in classification accuracy when presented with a larger sample set. Considerations for future work include developing an e-health digital computer based-system that reliably implements the processing steps summarized in the commercial implementation of a certified hardware prototype could then function as an effective diagnosis tool to aid in the diagnosis of individuals in regions where access to health care is limited.
INDIAN DIABETIC	Prasanna Porwal, Samiksha Pachade, Girish Deshmukh	2018	Diabetic Retinopathy (DR) is the result of microvascular retinal changes triggered by diabetes and it is the most

RETINOPATHY IMAGE DATASET			common leading cause of preventable blindness in the working-age population in the world. In India it is the sixth common cause of blindness Early diagnosis and treatment of DR can prevent vision loss. Hence, diabetic patients are referred to do a regular biannual or annual follow-up and frequent consultation for the screening of their retina. In the Indian subcontinent, against national eye care experts: population ratio of 1:107,000, in various regions this ratio is 1:9000 whereas in some other parts there is only one eye care expert for 608,000 population. Due to the large number of people that require a continuous follow-up and shortage of ophthalmologists, management of DR needs attention to develop computer-aided diagnosis tool. The recent technological advances in computing power, communication systems, and machine learning techniques provide opportunities to the biomedical engineers and computer scientists to meet the requirements of clinical practice. The raw images with ground truths facilitates the scientific community for development, validation, comparison and aid in the

			further improvement of DR lesion detection algorithms used in clinical application. Precise pixel level annotation of abnormalities associated with DR like microaneurysms, soft exudates, hard exudates and hemorrhages is invaluable resource for performance evaluation of individual lesion segmentation techniques. Whereas, the reliable information about disease severity level of DR, and DME is useful in development and evaluation of image analysis and retrieval algorithms for early detection of the disease.
PROPOSED RETINAL ABNORMALITY DETECTION AND CLASSIFICATION APPROACH	Valliappan Raman, Patrick, Putra Sumari	2016	Diabetic retinopathy is a common eye disease in diabetic patients and is the main cause of blindness in the population. Early detection of diabetic retinopathy protects patients from losing their vision. Thus, this paper proposes a computer-assisted diagnosis based on the digital processing of retinal images in order to help people detecting diabetic retinopathy in advance. The main goal is to automatically classify the grade of non-proliferative diabetic retinopathy at any retinal image. For that, an initial image processing stage isolates blood vessels, microaneurysms and hard

			exudates in order to extract features that can be used by a support vector machine to figure out the retinopathy grade of each retinal image. This proposal has been tested on a database of 400 retinal images labeled according to a 4-grade scale of non-proliferative diabetic retinopathy. As a result, we obtained a maximum sensitivity of 95% and a predictive capacity of 94%. Robustness with respect to changes in the parameters of the algorithm has also been evaluated.