**A MAJOR PROJECT REPORT ON**

**DETECTION OF DIABETIC RETINOPATHY USING DEEP LEARNING METHODOLOGY**

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**LITERATURE SURVEY**

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

**Abstract**

Importance: Deep learning is a family of computational methods that allow an algorithm to program itself by learning from a large set of examples that demonstrate the desired behavior, removing the need to specify rules explicitly. Application of these methods to medical imaging requires further assessment and validation. Objective: To apply deep learning to create an algorithm for automated detection of diabetic retinopathy and diabetic macular edema in retinal fundus photographs. Design and setting: A specific type of neural network optimized for image classification called a deep convolutional neural network was trained using a retrospective development data set of 128 175 retinal images, which were graded 3 to 7 times for diabetic retinopathy, diabetic macular edema, and image gradability by a panel of 54 US licensed ophthalmologists and ophthalmology senior residents between May and December 2015. The resultant algorithm was validated in January and February 2016 using 2 separate data sets, both graded by at least 7 US board-certified ophthalmologists with high intragrader consistency. Exposure: Deep learning-trained algorithm. Main outcomes and measures: The sensitivity and specificity of the algorithm for detecting referable diabetic retinopathy (RDR), defined as moderate and worse diabetic retinopathy, referable diabetic macular edema, or both, were generated based on the reference standard of the majority decision of the ophthalmologist panel. The algorithm was evaluated at 2 operating points selected from the development set, one selected for high specificity and another for high sensitivity. Results: The EyePACS-1 data set consisted of 9963 images from 4997 patients (mean age, 54.4 years; 62.2% women; prevalence of RDR, 683/8878 fully gradable images [7.8%]); the Messidor-2 data set had 1748 images from 874 patients (mean age, 57.6 years; 42.6% women; prevalence of RDR, 254/1745 fully gradable images [14.6%]). For detecting RDR, the algorithm had an area under the receiver operating curve of 0.991 (95% CI, 0.988-0.993) for EyePACS-1 and 0.990 (95% CI, 0.986-0.995) for Messidor-2. Using the first operating cut point with high specificity, for EyePACS-1, the sensitivity was 90.3% (95% CI, 87.5%-92.7%) and the specificity was 98.1% (95% CI, 97.8%-98.5%). For Messidor-2, the sensitivity was 87.0% (95% CI, 81.1%-91.0%) and the specificity was 98.5% (95% CI, 97.7%-99.1%). Using a second operating point with high sensitivity in the development set, for EyePACS-1 the sensitivity was 97.5% and specificity was 93.4% and for Messidor-2 the sensitivity was 96.1% and specificity was 93.9%. Conclusions and relevance: In this evaluation of retinal fundus photographs from adults with diabetes, an algorithm based on deep machine learning had high sensitivity and specificity for detecting referable diabetic retinopathy. Further research is necessary to determine the feasibility of applying this algorithm in the clinical setting and to determine whether use of the algorithm could lead to improved care and outcomes compared with current ophthalmologic assessment.

1. **Automatic Detection of Diabetic Retinopathy in Retinal Fundus Photographs Based on Deep Learning Algorithm**

**Abstract**

Purpose: To achieve automatic diabetic retinopathy (DR) detection in retinal fundus photographs through the use of a deep transfer learning approach using the Inception-v3 network.

Methods: A total of 19,233 eye fundus color numerical images were retrospectively obtained from 5278 adult patients presenting for DR screening. The 8816 images passed image-quality review and were graded as no apparent DR (1374 images), mild nonproliferative DR (NPDR) (2152 images), moderate NPDR (2370 images), severe NPDR (1984 images), and proliferative DR (PDR) (936 images) by eight retinal experts according to the International Clinical Diabetic Retinopathy severity scale. After image preprocessing, 7935 DR images were selected from the above categories as a training dataset, while the rest of the images were used as validation dataset. We introduced a 10-fold cross-validation strategy to assess and optimize our model. We also selected the publicly independent Messidor-2 dataset to test the performance of our model. For discrimination between no referral (no apparent DR and mild NPDR) and referral (moderate NPDR, severe NPDR, and PDR), we also computed prediction accuracy, sensitivity, specificity, area under the receiver operating characteristic curve (AUC), and κ value.

1. **Multi-Scale Attention Network for Diabetic Retinopathy Classification (2021)**

**Abstract**

Diabetic Retinopathy (DR) is a highly prevalent complication of diabetes mellitus, which causes lesions on the retina that affect vision which may lead to blindness if it is not detected and diagnosed early. Convolutional neural networks (CNN) are becoming the state-of-the-art approach for automatic detection of DR by using fundus images. The high-level features extracted by CNN are mostly utilised for the detection and classification of lesions on the retina. This high-level representation is capable of classifying different DR classes; however, more effective features for detecting the damages are needed. This paper proposes the multi-scale attention network (MSA-Net) for DR classification. The proposed approach applies the encoder network to embed the retina image in a high-level representational space, where the combination of mid and high-level features is used to enrich the representation. Then a multi-scale feature pyramid is included to describe the retinal structure in a different locality. Furthermore, to enhance the discriminative power of the feature representation a multi-scale attention mechanism is used on top of the high-level representation. The model is trained in a standard way using the cross-entropy loss to classify the DR severity level. In parallel as an auxiliary task, the model is trained using the weakly annotated data to detect healthy and non-healthy retina images. This surrogate task helps the model to enrich its discriminative power for distinguishing the non-healthy retina images. The proposed method when implemented has achieved outstanding results on two public datasets: EyePACS and APTOS.