R&D Report

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R & D Project Evaluation I

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Project Id - **27**

Automatic Diabetic Macular Edema Detection from Color Fundus Images

Submitted by

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1. Problem Statement:

- Diabetic Macular Edema (DME), caused by diabetes, is an complex symptom of diabetic retinopathy and may cause to **permanent vision loss**.
- The ratio of ophthalmologists to the population in developing countries like India is 1:24,000 in cities and 1:220,000 in villages. Thus there is a need for automatic detection.
- The goal, therefore, is to automate the detection of DME by using a trained CNN module from scratch.

2. Literature Survey:

D. Marin et al[1] first established a ground truth diagnosis about the presence of DME on the images obtained from the Messidor Dataset. The supervised classification process is implemented after digital image processing algorithms are applied on the dataset. The accuracy of the system was 89% only for detection, skipping DME grading.

Deepak[2] focuses on the detection and classification of DME severity. For the detection, the extraction of ROI is done, then features are derived that classifies the image as normal or abnormal through single class classification. Then the severity of DME is classified by measuring lack of symmetry of the macula. The paper uses four datasets: the DMED dataset, Messidor dataset,Diaretdb1and Diaretdb0 dataset. An average accuracy for detection of 92% and 53% accuracy for moderate and 100% for severe grading is achieved.

Renoh et al.[3] establishes a new method for the automated screening of the CSME based on the location of exudates. The automation of the identification of CSME is performed on the MESSIDOR dataset and obtains 90% accuracy. CNN with a k-NN module is used to classify the data into CSME and Non-CSME.

Jun Wu[4] The paper suggests a unique approach that uses Faster R-CNN and MD-ResNet to grade diabetic macular edema with 94.4% and 87% accuracy on HEI-MED and E-ophtha, respectively. It uses a polar coordinate system with the macula as its center of reference and focuses on microaneurysms, deposits, and hard exudates. Three methods are presented, including positional relationships ,vascular connections and deep learning.

Jaakko sahlsten[5]The research effectively automates diabetic retinopathy and maculopathy screening using deep learning, demonstrating good performance despite a small dataset. Bigger inputs require more processing but increase efficacy. It is important to strike a balance between cost and resolution, and higher resolution calls for optimisation. When screening for

diabetic retinopathy and maculopathy, the ensemble approach using 512x512 retinal pictures improves overall efficiency and shortens the training period.

3. Gap and Challenges

Ref No.	Gaps	Challenges
a	1. Only performs DME detection, skips DME grading based on severity.	1. Dataset utilized is very small.
b	1. Doesn't explore a wide range of lesion sizes	1. Class Imbalance Problem
c	1. The trained CNN model might not give accurate results for all datasets. 2. The method followed is unsupervised.	1. Intra Class Variance
d	1. Less Training Data for HE Segmentation 2. Consistent Resizing for Macular Centre Placement 3. CNN Efficiency issues.	1. Hard Exudate Variability 2. Deep learning accuracy issues arise when macular localization relies on accurate optic disc position.
e	1. Image grading may introduce biases. 2. Model worked well with a small dataset, unclear how it would function with larger and more varied image sets.	1. Using high-resolution training images slows down procedures and increases computational requirements. 2. Although the model demonstrated good performance on a small dataset, its performance on larger and more diverse image datasets remains untested, which presents a difficulty.

4. References

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[4] Jun Wu · Qianqian Zhang · Mengjia Liu · Zhitao Xiao · Fang Zhang · Lei Geng · Yanbei Liu · Wen Wang, "Diabetic macular edema grading based on improved Faster R-CNN and MD-ResNet", Springer-Verlag London Ltd., part of Springer Nature 2020

[5] Jaakko sahlsten, Joel Jaskari, Jyri Kivinen, Lauri turunen, esa Jaanio, Kustaa Hietala & Kimmo Kaski1,"Deep Learning Fundus Image Analysis for Diabetic Retinopathy and Macular edema Grading",Scientific Reports

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