

Title: GDRNet: A Novel Graph Neural Network Architecture for Diabetic Retinopathy Detection

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Abstract: Diabetic retinopathy is a significant cause of global blindness, requiring practical early detection approaches that could save vision loss in millions of people. However, manual DR analysis is time-consuming and requires skilled clinicians. The advancement of artificial intelligence can facilitate early DR predictions. This study proposed GDRNet, a novel AI-empowered diagnosis system that utilizes graph theory for effective feature selection in DR grading classification. The EyePACS, Messidor, APTOS, IDRI, and DDR datasets are initially balanced using the nearest neighbor oversampling approach. A deep graph correlation network (DGCN) extracts unique features from color eye fundus images by identifying intra-class connections. Then, an iterative random forest algorithm is employed for feature curation, ranking the most significant features from the DGCN. Subsequently, the iterative random forest enhances classification robustness by refining feature representations and aggregating multi-scale contextual information. Finally, a classifier using extreme gradient boosting based on a decision tree algorithm is trained with the optimized features to predict the outcomes. Experimental results reveal that GDRNet outperforms state-of-the-art DR grading classification methods with outstanding performance across various datasets: 100% specificity, 99.67% sensitivity, and 99.80% accuracy on Messidor; 100% specificity, 99.61% sensitivity, and 99.41% accuracy on APTOS; and comparable results on IDRI and DDR datasets. On the EyePACS dataset, it achieves 100% specificity, 99.20% sensitivity, and 99.50% accuracy. Based on these numerical findings, we expect that GDRNet could be utilized in healthcare for early and automated DR detection.

Keywords: Diabetic retinopathy (DR), Artificial intelligence (AI), GDRNet, Deep graph correlation network (DGCN), Feature selection, Iterative random forest, Extreme gradient boosting (XGBoost).

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