Next-generation Diagnostic Precision: A Tailored Deep Neural Network for Alzheimer's Disease Classification in MRI

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Talk Abstract

Alzheimer's Disease (AD) is a devastating neurological disorder that severely impacts millions of individuals worldwide, leading to significant deterioration in memory, cognitive functions, and behavioral patterns [1]. Early and accurate diagnosis is critical for managing and treating AD effectively [2] . This study introduces a novel AD classification model that combines cutting-edge deep learning techniques with advanced feature extraction [3], adaptive weighting, and optimized hidden layers to achieve unprecedented levels of accuracy and efficiency [4]. Our model leverages deep Convolutional Neural Networks (CNN) for robust feature extraction, focusing on critical biomarkers associated with AD. This approach ensures that the model can accurately capture the subtle differences in brain MRI scans indicative of various stages of AD. By integrating adaptive weights and optimized hidden layers, the model enhances classification performance while maintaining computational efficiency. To address the significant class imbalance in the Kaggle MRI image dataset [5], we employ a synthetic oversampling technique to ensure an even distribution of images across different classes, improving the model's generalizability. The proposed Alzheimer's Disease Detection Network (ADD-Net) is rigorously evaluated against established models such as DenseNet169, VGG19, and InceptionResNet V2 using metrics like precision, recall, F1-score, Area Under the Curve (AUC), and loss. The model achieves exceptional performance metrics: 99.51% accuracy, 99.51% precision, 99.51% sensitivity (recall), 1.000% AUC, 99.51% F1 score, 0.0138% loss, and 99.32% ROC. This research not only advances the field of AD classification but also sets a new benchmark for diagnostic tools. The integration of adaptive weights and optimized hidden layers within a deep CNN framework leads to superior performance across all evaluation metrics. The streamlined architecture of our model demonstrates that high precision and accuracy can be achieved without excessively increasing model complexity or computational demands. The exceptional performance metrics underscore the model's potential as a reliable and powerful tool for AD diagnosis, highlighting its superiority over existing models and setting a new standard in the domain.

Keywords: Deep Learning, Supervised Learning, Image Classification, Imbalanced Dataset.

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