ABSTRACT

Alzheimer’s disease is a progressive neurodegenerative disorder and the leading cause of cognitive impairment in the elderly, with a globally increasing prevalence. Early diagnosis is crucial to slow disease progression and improve patients' quality of life. However, manual interpretation of Magnetic Resonance Imaging (MRI) scans is often ineffective, especially in the early stages of the disease, and faces challenges such as data imbalance, where minority classes are frequently underrepresented. This study aims to enhance the accuracy of alzheimer’s diagnosis by implementing the EfficientNetB0 model on MRI images from the Alzheimer’s disease Neuroimaging Initiative (ADNI) dataset, utilizing the Synthetic Minority Oversampling Technique (SMOTE) to address data imbalance and data augmentation to increase variability. The model was trained and tested on three data scenarios, that is original data, SMOTE-applied data, and augmented data. The findings demonstrate that SMOTE improves the model's sensitivity to minority classes, while data augmentation enhances dataset variability, yielding the best performance with an accuracy of 0,9836 and a macro f1-score of 0,9773. Grad-CAM analysis revealed that the model focuses more on relevant brain regions after applying augmentation or SMOTE techniques. These findings indicate that combining EfficientNetB0 with SMOTE and data augmentation significantly improves the accuracy of Alzheimer’s diagnosis. This study highlights the effectiveness of Deep Learning in addressing data imbalance challenges and the limitations of manual methods, contributing to the development of more accurate, efficient, and practical medical diagnostic technologies for early detection of Alzheimer’s disease.

Keywords : Alzheimer, Data Augmentation, Deep Learning, EfficientNetB0, SMOTE