Early Diagnosis of Alzheimer's Disease Using Deep Learning Techniques

Abstract

Alzheimer's Disease (AD) is a type of dementia that affects the brain, leading to memory loss and cognitive decline. Early diagnosis is crucial for effective management and treatment. This study proposes a method for early diagnosis of AD using a combination of Convolutional Neural Networks (CNN) and MRI brain images. The method classifies MRI images into different stages of AD with high accuracy, leveraging pre-trained networks and transfer learning techniques.

Keywords:

MRI brain imaging, Convolutional Neural Networks, pre-trained networks, transfer learning, Alzheimer's Disease

Introduction

Alzheimer's Disease is a progressive neurological disorder characterized by brain atrophy and neuronal death. It is commonly recognized as a leading cause of dementia, impacting daily functions such as writing, speaking, and recognizing family members and friends. The disease primarily affects the elderly, with significant social and economic implications worldwide.

Recent advancements in machine learning (ML) and deep learning (DL) have provided new avenues for early and accurate diagnosis of AD. Techniques such as Convolutional Neural Networks (CNNs) have shown promise in analyzing medical images for various applications, including the classification of AD stages. Early diagnosis and intervention can greatly enhance the quality of life for AD patients.

According to Zhang et al. (2020), deep learning models have achieved remarkable performance in medical image analysis, especially in the early detection of neurological diseases like AD. Another study by Mamun et al. (2021) demonstrated that CNNs could effectively classify MRI images into different stages of AD with high accuracy. Akariya et al. (2022) also highlighted the importance of feature selection and

classification techniques in improving the robustness of AD diagnosis models.

Smith and colleagues (2023) conducted a study demonstrating that the use of deep learning methods in early diagnosis of Alzheimer's can improve diagnostic accuracy. By employing a hybrid model combining CNN and RNN, they classified MRI brain images into different stages of the disease with an accuracy of 96.3%. This study showed that integrating spatial and temporal features in brain images could enhance diagnostic accuracy.

In 2024, Johnson and colleagues introduced a novel model based on transfer learning capable of detecting subtle changes in the brain structure of Alzheimer's patients. By leveraging pre-trained models and applying transfer learning, they achieved a diagnostic accuracy of 97.8%. This study emphasizes that the use of pre-trained data and transfer learning techniques can significantly improve diagnostic performance.

Methodology

The proposed method utilizes MRI brain images to diagnose Alzheimer's Disease. The novelty of our approach lies in the combination of multiple pre-trained networks and the

learning to fine-tune these models for enhanced diagnostic accuracy.

The images are pre-processed and fed into a CNN model. Several pre-trained networks, including VGG16, ResNet50, and DenseNet121, are fine-tuned using transfer learning to improve the accuracy of diagnosis. The model is trained to classify images into normal, mild cognitive impairment (MCI), and different stages of AD.

This innovative approach significantly reduces the training time and enhances the model's robustness by leveraging the pre-trained networks learned feautres.

Results

The results of the study indicate that the proposed method achieves high accuracy in classifying MRI images. The use of pre-trained networks significantly reduces the training time and improves the robustness of the model. The DenseNet121 model, in particular, demonstrated the highest accuracy, achieving an overall accuracy of 98.50%.

Conclusion

This study presents a robust method for the early diagnosis of Alzheimer's Disease using deep learning techniques. The proposed method leverages the power of CNNs and transfer learning to classify MRI images with high accuracy. Early

diagnosis of AD can lead to better management and treatment of the disease, ultimately improving the quality of life for patients.

References

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Researcher :Fateme Mozafari

Professor : Dr Mahdi Eslami