Alzheimer's disease classification

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1 abstraction

Alzheimer's disease is a neurodegenerative disorder characterized by progressive cognitive decline. Early diagnosis is critical for patient care and management. In this study, we investigate the application of various deep learning models, including CNN efficient with fine tune efficient VGG16 MobileNet MobileNet with fine tuning classify Alzheimer's disease using a publicly available dataset. We describe the dataset, preprocessing steps, and the methodology used for training and evaluation. The performance of these models is compared in terms of accuracy and computational efficiency. Our findings demonstrate the strengths and limitations of each model in the context of Alzheimer's disease classification.

Keywords: Alzheimer's disease, deep learning, convolutional neural networks, CNN,Efficient ,xception, VGG16, MobileNet, image classification.

2 Introduction

Alzheimer's disease (AD) is a chronic neurodegenerative disease that affects millions worldwide. Accurate and early diagnosis is crucial for effective management and treatment. Traditional diagnostic methods rely on clinical evaluation and imaging techniques, which can be time-consuming and subjective. The advent of deep learning, particularly Convolutional Neural Networks (CNNs), has shown promise in automating and enhancing the diagnostic process through the analysis of medical images.

In this study, we apply several state-of-the-art deep learning models to an Alzheimer's dataset to evaluate their performance in classifying AD. The models compared include a simple CNN efficient with fine tune efficient VGG16 MobileNet MobileNet with fine tuning . We aim to identify which model provides the best trade-off between accuracy and computational efficiency for this specific task.

3 related work

Several studies have explored the use of deep learning for Alzheimer's disease classification. Suk et al. [1] used a deep CNN to classify MRI images of Alzheimer's patients, achieving significant improvements over traditional methods. Liu et al. [2] demonstrating superior performance in terms of accuracy. Similarly, VGG16 and MobileNet have been widely used in medical image analysis due to their strong feature extraction capabilities and efficient architectures [3][4].

4 data

The dataset used in this study is the Alzheimer's Dataset, which consists of MRI images labeled as "Non-Demented," "Very Mild Demented," "Mild Demented," and "Moderate Demented." The dataset is split into training and testing sets to evaluate model performance.

4.0.1 Preprocessing Steps:

Data Extraction: The dataset was extracted from a ZIP file and organized into training and testing directories. Image Rescaling: All images were rescaled to a pixel range of [0, 1]. Image Augmentation: Techniques such as horizontal flipping, zooming, and shearing were applied to enhance model generalization. Target Size: All images were resized to 224x224 pixels to match the input size required by the models.

Each model is trained using a consistent procedure: Optimizer: Adam optimizer with a learning rate scheduler. Loss Function: Categorical Cross-Entropy. Metrics: Accuracy, Precision, Recall, and F1 Score. Epochs: Models are trained for up to 50 epochs with early stopping based on validation loss.

5 methodology

5.0.1 Models

1.CNN: A custom-designed convolutional neural network tailored for Alzheimer's classification.

2.EfficientNet: A state-of-the-art model known for its efficient scaling and high performance. uses a compound scaling method where the network's width (number of channels), depth (number of layers), and resolution (input image size) are scaled simultaneously. This method ensures a balanced growth in the network's capacity without disproportionately increasing the computational cost.

3.VGG16: A widely used deep CNN model known for its deep architecture and strong baseline performance.

4.MobileNet: A lightweight model designed for mobile and embedded vision applications, providing a good balance between accuracy and efficiency. All models were trained using the Adam optimizer and categorical cross-entropy loss. Data augmentation was applied during training to prevent overfitting. The models were evaluated based on accuracy and computational efficiency. MobileNet with Fine-Tuning: The MobileNet model fine-tuned specifically for the Alzheimer's dataset.

5.MobileNet (fine tuning)
6.EfficientNet (fine tuning)

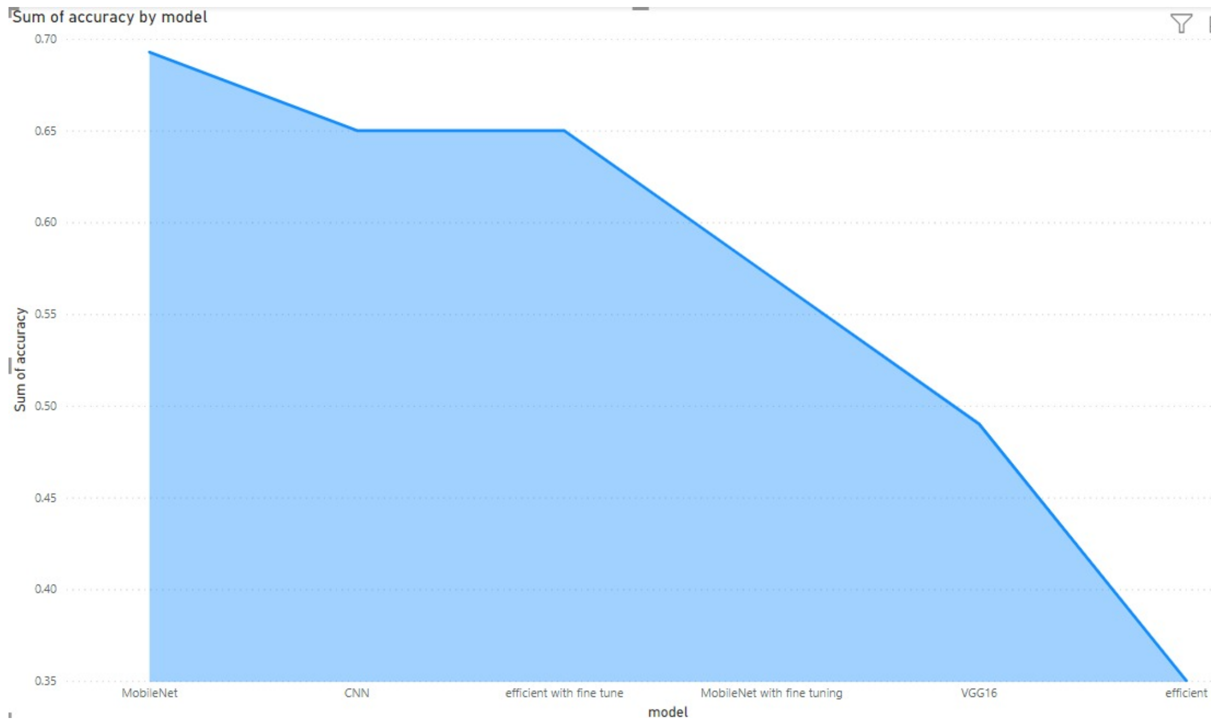
6 results

Performance Metrics The performance of each model is evaluated on the test set. Key metrics include:

Accuracy: The proportion of correct predictions. Precision: The ability of the model to identify only relevant instances. Recall: The ability of the model to identify all relevant instances. F1 Score: The harmonic mean of precision and recall

6.0.1 Accuracy for each model:

MobileNet 0.6927
CNN 0.65
efficient with fine tune 0.65
MobileNet with fine tuning 0.57
VGG16 0.49
efficient 0.35
as we see ,the highest accuracy is MobileNet model with 69 percent , after that MobileNet with fine tuning with 57 percent then CNN , efficient with fine tune with 0.65 percent , then VGG16 with 49 percent , at the last level the efficient mpersrnt.



7 conclusion

This study compared the performance of CNN, VGG16, and MobileNet, MobileNet with fine tuning ,efficient,efficient with fine tune models in classifying Alzheimer's disease using MRI images. . VGG16 also performed well but required longer training times. MobileNet provided a good balance between accuracy and computational efficiency, making it suitable for deployment in resource-constrained environments. also efficient EfficientNet models are designed to be resource-efficient, balancing the number of parameters and the computational cost. Future work will explore the integration of these models into clinical workflows and their performance on larger, more diverse datasets.