

# EARLY DETECTION OF ALZHEIMER'S DISEASE FROM BRAIN MRI USING VGG16- BASED DEEP LEARNING

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**ABSTRACT** - Alzheimer's disease (AD) is a progressive neurodegenerative disorder that leads to memory loss and cognitive decline. Early diagnosis is essential for effective disease management and improved patient outcomes. This paper presents an automated deep learning-based approach for early detection of Alzheimer's disease using brain MRI images and a VGG16-based convolutional neural network. Transfer learning is employed to fine-tune the pre-trained VGG16 model for identifying disease-specific patterns in MRI scans. Image normalization and data augmentation are applied to enhance model performance and generalization. Experimental results show that the proposed model achieves high accuracy while reducing reliance on manual diagnosis, making it a reliable and scalable tool for clinical decision support.

**KEYWORDS** - Alzheimer's Disease, Brain MRI, Deep Learning, VGG16, Convolutional Neural Network, Transfer Learning, Medical Image Analysis, Early Diagnosis

**1. INTRODUCTION** - Alzheimer's disease (AD) is one of the leading causes of dementia worldwide, characterized by progressive memory loss and cognitive impairment. Early detection is crucial to slow disease progression and support timely treatment. MRI is widely used to identify structural brain changes associated with AD; however, conventional diagnostic methods rely heavily on manual analysis, which is time-consuming and subjective.

Recent advances in deep learning, particularly convolutional neural networks (CNNs), have enabled automated and accurate medical image analysis. VGG16, a well-known CNN architecture, has demonstrated strong performance in image classification tasks. This work proposes a VGG16-based deep learning framework using transfer learning for early detection of Alzheimer's disease from brain MRI images, aiming to improve diagnostic accuracy and efficiency.

## 1.1 SCOPE OF THIS PROJECT

The scope of the proposed project includes the following:

- To develop an automated deep learning-based system for early detection of Alzheimer's disease using brain MRI images.
- To utilize a VGG16-based convolutional neural network with transfer learning for accurate feature extraction and classification.
- To apply image preprocessing techniques such as normalization and data augmentation to improve model robustness and performance.
- To reduce dependency on manual diagnosis and minimize human error in Alzheimer's disease detection.
- To provide a scalable and efficient diagnostic framework that can assist healthcare professionals in clinical decision-making.
- To enable early-stage detection of Alzheimer's disease, supporting timely medical intervention and improved patient outcomes.
- To serve as a foundation for future research, including multi-stage Alzheimer's classification and extension to other neurological disorders.

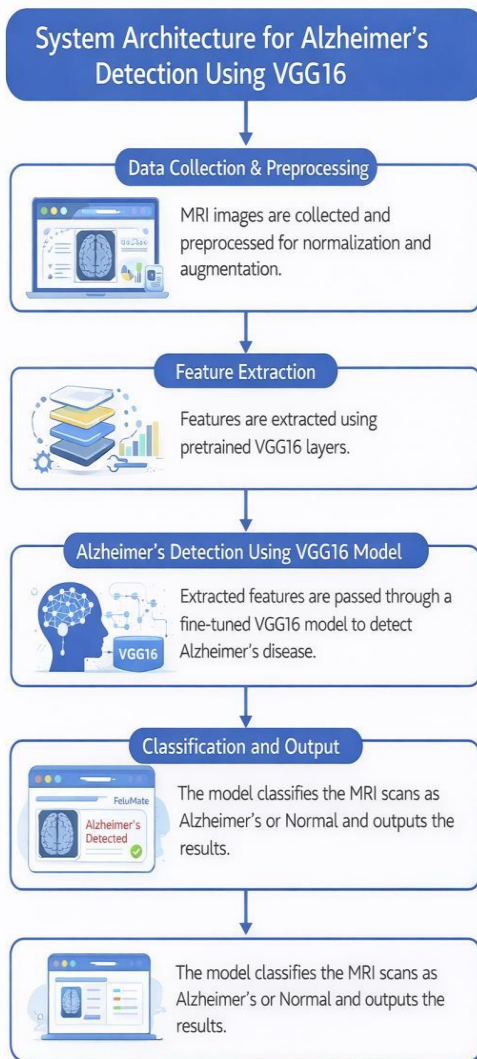
## 2. PROPOSED WORK

The proposed work focuses on developing an automated deep learning framework for early detection of Alzheimer's disease using brain MRI images. The system leverages the power of transfer learning by employing a pre-trained VGG16 convolutional neural network, which is fine-tuned to identify Alzheimer's-specific patterns in MRI scans.

The framework begins with the acquisition of MRI images, followed by preprocessing steps such as resizing, normalization, and data augmentation. These steps ensure uniform input data and improve model robustness. The VGG16 model automatically extracts high-level features from the processed images, eliminating the need for manual feature engineering.

The extracted features are used to classify MRI images into normal and Alzheimer-affected categories. The proposed system aims to deliver accurate, fast, and consistent diagnostic results, supporting healthcare professionals in early-stage disease identification and decision-making.

## 2.1 System Architecture



### 3.1 Data Processing & Preprocessing:

To ensure reliable feature learning and accurate early detection of Alzheimer's disease, the proposed VGG16-based deep learning framework incorporates a systematic data processing and preprocessing pipeline.

- **Data Collection:** Brain Magnetic Resonance Imaging (MRI) scans are collected from publicly available and clinically validated datasets.
- **Input Preprocessing:** The collected MRI images undergo preprocessing to

enhance image quality and ensure compatibility with VGG16 architecture.

- **Noise Reduction and Enhancement:** Basic filtering techniques are applied to minimize noise and artifacts present in MRI scans
- **Data Augmentation:** To address dataset limitations and prevent overfitting, data augmentation techniques such as rotation, flipping, scaling, and zooming are applied.
- **Feature Preparation for VGG16:** Preprocessed images are formatted and fed into the pretrained VGG16 network.

## 3.2 Brain MRI Enhancement and Alzheimer's Severity Analysis

### 3.2.1 Brain Image Augmentation:

Brain image augmentation is used to expand MRI datasets by applying transformations such as rotation, flipping, and scaling. This process reduces overfitting, improves model generalization, and helps the deep learning model learn robust features from limited medical data.

### 3.2.2 Alzheimer's Level Identification:

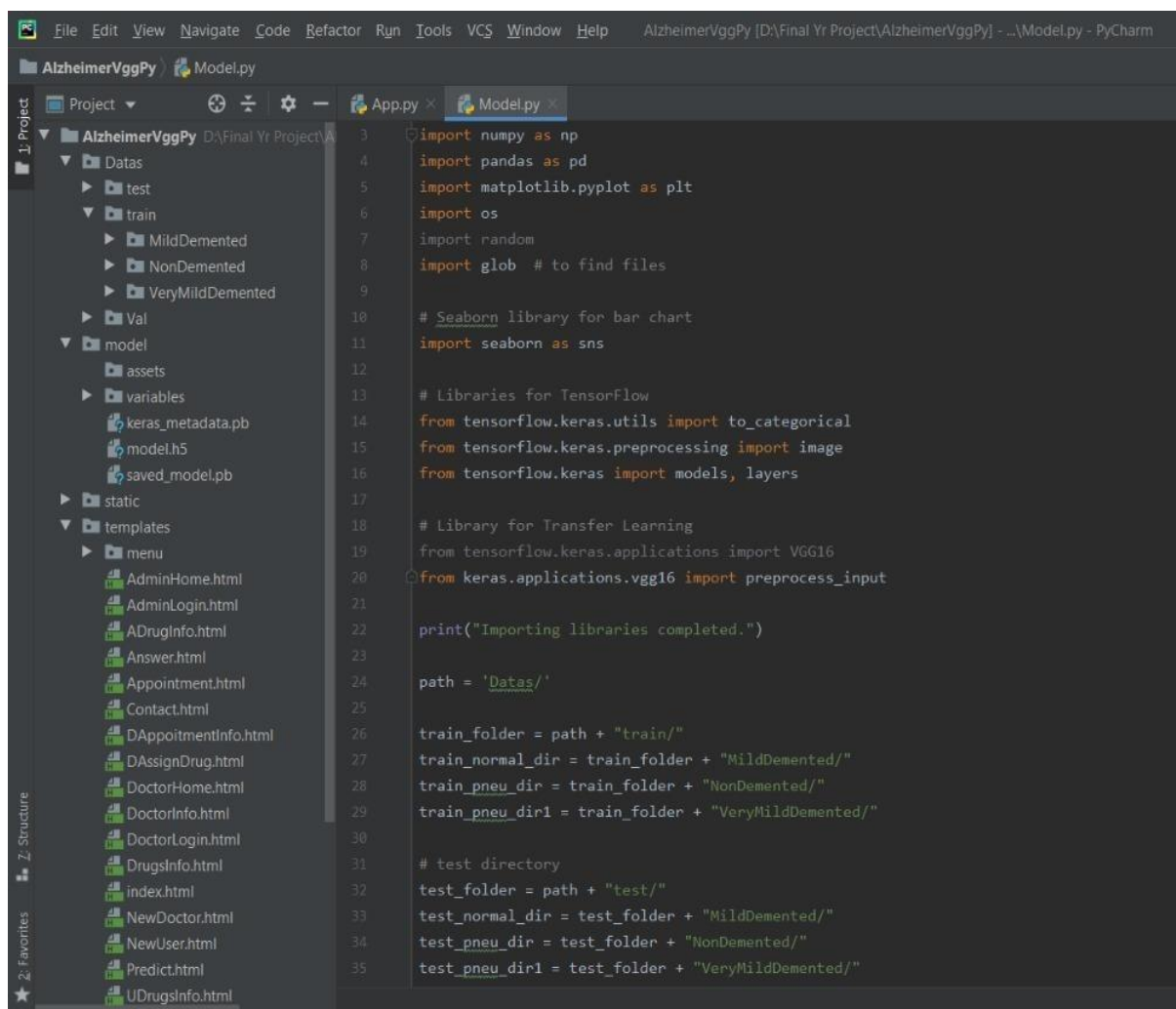
A fine-tuned VGG16 model classifies brain MRI images into different Alzheimer's disease stages, from mild cognitive impairment to severe levels. This automated classification supports early diagnosis, disease progression monitoring, and efficient clinical decision-making.

## 3.2 TOOLS AND LIBRARIES

The implementation of the proposed system utilizes the following tools and software libraries:

- **Python:** Used as the primary programming language for model development and experimentation.
- **TensorFlow:** Employed for building and training the deep learning model.
- **Keras:** Used as a high-level neural network API for implementing the VGG16 architecture.
- **OpenCV:** Applied for image preprocessing operations such as resizing and normalization.
- **NumPy:** Used for numerical computations and array operations.
- **Pandas:** Utilized for data handling and dataset management.
- **Matplotlib:** Used for visualizing training performance and output results.

## 4. PROGRAM



The screenshot shows the PyCharm IDE interface. The left sidebar displays the project structure for 'AlzheimerVggPy'. The main editor window shows the code for 'Model.py'.

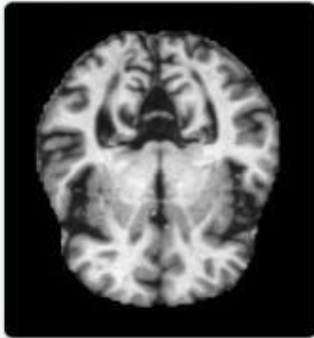
```
3 import numpy as np
4 import pandas as pd
5 import matplotlib.pyplot as plt
6 import os
7 import random
8 import glob # to find files
9
10 # Seaborn library for bar chart
11 import seaborn as sns
12
13 # Libraries for Tensorflow
14 from tensorflow.keras.utils import to_categorical
15 from tensorflow.keras.preprocessing import image
16 from tensorflow.keras import models, layers
17
18 # Library for Transfer Learning
19 from tensorflow.keras.applications import VGG16
20 from keras.applications.vgg16 import preprocess_input
21
22 print("Importing libraries completed.")
23
24 path = 'Datas/'
25
26 train_folder = path + "train/"
27 train_normal_dir = train_folder + "MildDemented/"
28 train_pneu_dir = train_folder + "NonDemented/"
29 train_pneu_dir1 = train_folder + "VeryMildDemented/"
30
31 # test directory
32 test_folder = path + "test/"
33 test_normal_dir = test_folder + "MildDemented/"
34 test_pneu_dir = test_folder + "NonDemented/"
35 test_pneu_dir1 = test_folder + "VeryMildDemented/"
```

## 5. RESULTS AND OUTPUT

### Prediction Result

View the processed heart scan and the final prediction result.

**Uploaded Image**



**After Noise Removal**  
No processed image available.

**Prediction Result:**  
MildDemented

[View Doctor Info](#)

## 6. CONCLUSION

This paper presents an effective deep learning-based approach for the early detection of Alzheimer's disease using brain MRI images. By employing a VGG16-based convolutional neural network with transfer learning, the proposed system achieves reliable and accurate classification while minimizing manual intervention.

The automated framework reduces diagnostic time and improves consistency compared to traditional methods. The results demonstrate that deep learning models can serve as valuable tools in medical image analysis and clinical decision support. Future enhancements may include multi-stage Alzheimer's classification and the integration of additional clinical or multimodal data to further improve diagnostic performance.

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