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Early Detection of Alzheimers Disease through Deep Learning in MRI Scans

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Abstract: Alzheimer's disease (AD) is a neurodegenerative disorder characterized by progressive cognitive decline and memory impairment, leading to dementia and irreversible decline in cognitive abilities. This disease causes the person to suffer from memory loss, unusual behaviour, and language problems.
The initial symptoms, such as episodic memory impairment and the navigational problem of the patient, are typical variants. In the proposed system we are using The Deep Learning Models as Modified CNN along with MobileNet, and VGG16 algorithms and classify the images as either Mild Demented or Moderate Demented or Non-Demented or Very Mild Demented. In this study we are using Augmented ADNI dataset which consists of 40000 images.
This can be utilized in the future to classify the types of different classifications easily which is easy to find out the infections in initial stages and can be cured in the initial stages only.
Keywords: Alzheimer's disease, Deep Learning, Augmented, ADNI, Convolutional Neural Networks (CNN), VGG16, MobileNet, Accuracy and Loss.

I. INTRODUCTION

Alzheimer's disease (AD) is a progressive neurodegenerative disorder that affects millions of people worldwide. Early detection of AD is crucial for timely intervention and management of the disease. Magnetic resonance imaging (MRI) is a widely used imaging modality for the diagnosis of AD due to its ability to capture detailed structural information of the brain. However, manual interpretation of MRI scans for AD diagnosis is time- consuming and subjective, leading to a growing interest in automated and objective methods.

Although being old is the main risk factor, AD is not only an old age illness. The memory loss starts off minor, but as it progresses, the patient's ability to reply, converse, and carry on a conversation significantly worsens. Although there is no cure for Alzheimer's disease (AD) at this time, early detection can help people live better lives and reduce the severity of the condition. According to reports, the number of people with AD will double in the next 20 years (Zhang. 2011), and by 2050, 1 in 85 people would be afflicted (Ron Brookmeyer, 2007).

Therefore, it's critical to have an accurate diagnosis, especially in the early stages of AD. A productive cough, fever with shivering chills, shortness of breath, a sharp or stabbing chest discomfort during deep breathes, and an accelerated pace of breathing are all common symptoms of infectious pneumonia.

Different neuroimaging techniques, including resting-state functional magnetic resonance imaging (rs fMRI), structural magnetic resonance imaging (sMRI), and positron emission tomography (PET), can distinguish the histopathological changes linked to these diseases. As a result, they are being used more frequently for the medical analysis of AD and MCI.

Deep learning, a subfield of artificial intelligence, has shown promising results in various medical imaging tasks, including the detection and classification of AD using MRI scans.

Convolutional neural networks (CNNs) are particularly well-suited for processing images and have been extensively used in medical image analysis tasks. Among the CNN architectures, VGG16 and MobileNet have gained popularity for their effectiveness in feature extraction and classification tasks.

This paper presents a detailed investigation into the application of deep learning techniques, specifically CNNs, VGG16, and MobileNet, for the automated detection of Alzheimer's disease in MRI scans. The primary objective is to compare the performance of these architectures in terms of accuracy and computational efficiency.

II. LITERATURE SURVEY

1) *Backstrom, K., Nazari, M., Gu, I.Y., Jakola, A.S.: An efficient 3D deep convolutional network for Alzheimer's disease diagnosis using MR images. In: 2018 IEEE 15thlnternational Symposium on Biomedical Imaging (ISBI 2018), pp. 149-153, April 2018.*

https://doi.org/10.1109/ISBI.2018.8363543:

Alzheimer's Disease (AD) diagnosis and Automatic feature extraction from MRI brain Images remain difficult tasks. In this article, we present a three-dimensional convolutional network (3D ConvNet) architecture that is quick, effective, and able to diagnose Alzheimer's disease (AD) on a sizable dataset. Three fully connected layers for AD/NC classification follow five convolutional layers for feature extraction in the proposed 3D ConvNet. The following are the primary contributions of the paper: (a) the proposal of an unique and efficient 3D ConvNet architecture (b) the analysis of the effects of pre-processing, data partitioning, and hyperparameter selection on the performance of AD classification. Studies using an ADNI dataset of 340 participants and 1198 MRI brain scans have produced consistent results (with a test accuracy of 98.74%, a 100% AD detection rate, and a false alarm rate of 2.4%). The robustness of the suggested technique has been strongly supported by comparisons with 7 current state-of-the-art methods.

2) *Cui, R., Liu, M.: Hippocampus analysis by combination of 3-D DenseNet and shapes for Alzheimer's disease diagnosis, IEEE J. Biomed. Health Inform. 23(5), 2099-2107 (2019).*

https://doi.org/10.1109/JBHI.2018.2882392CrossRef:

In Alzheimer's disease (AD) and moderate cognitive impairment (MCI), a prodromal stage of AD, the hippocampus is one of the first areas to get affected. A reliable, accessible, and often utilised biomarker for the diagnosis of AD is hippocampal shrinkage. In most cases, structural magnetic resonance images are used to calculate shape and volume characteristics for hippocampal analysis (MRI). The visual characteristics of the hippocampal region are crucial for the diagnosis of the illness, and the areas around the hippocampus may be significant to AD. With the use of three-dimensional densely linked convolutional networks and shape analysis, we have suggested a new hippocampus analysis technique in this research for the diagnosis of AD. This technique combines the global and local properties of the hippocampus. The proposed. method can make use of the local visual and global shape features to enhance the classification.

III. METHODOLOGY

A. Data Acquisition and Preprocessing

Obtain MRI scans of individuals diagnosed with Alzheimer's disease and healthy controls from publicly available datasets or clinical repositories. Preprocess the MRI data to ensure uniformity and remove artifacts, including skull stripping, intensity normalization, and spatial normalization. Split the dataset into training, validation, and testing sets, ensuring a balanced distribution of AD and non-AD cases.

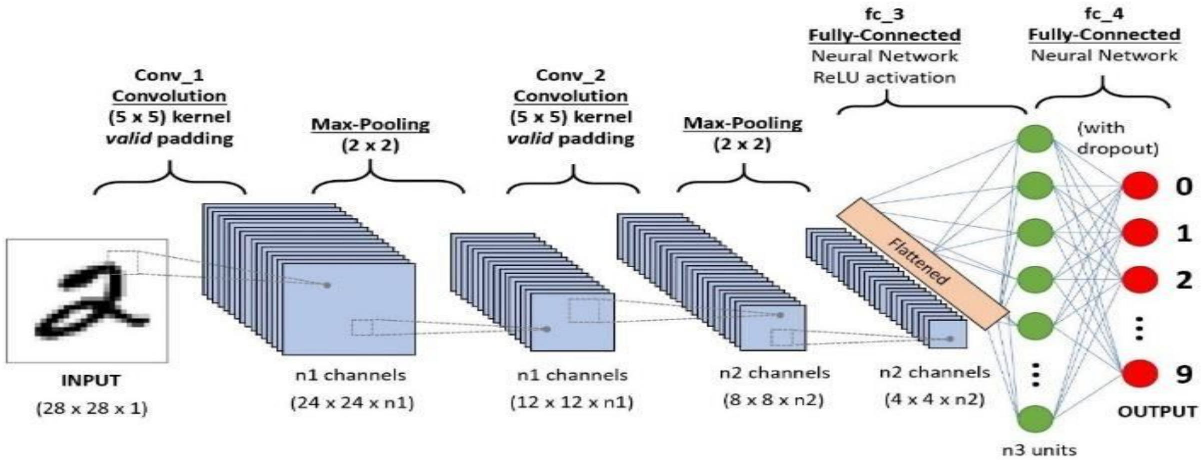
B. Deep Learning

The work consists of using different convolution neural networks based on architectures such as Convolutional Neural Network (CNN) and Visual Geometry Group (VGG16) & MobileNet Model. These three architectures showcased high performance in the classification challenge

C. Convolutional Neural Networks (ConvNets)

Convolutional Neural Networks (CNNs) have emerged as powerful tools in the field of medical image analysis, including the detection and classification of Alzheimer's disease (AD) from MRI scans. CNNs are a type of deep neural network specifically designed for processing structured grid-like data, such as images. They are composed of multiple layers, including convolutional layers, pooling layers, and fully connected layers, each responsible for extracting and learning increasingly abstract features from the input data.

Overall, CNNs represent a powerful framework for Alzheimer's disease detection through deep learning in MRI scans, offering robustness, scalability, and automated feature extraction capabilities essential for developing accurate and clinically relevant diagnostic tools. As research in this field Progresses, further advancements in CNN architectures and interpretability techniques are expected to contribute to improved AD detection and patient care.



1-Input, 2-Convolution, 3-Pooling , 4-Fully Connected, 5-Output, 6-Feature Extraction, 7-Classification

Fig. 1. Convolutional Neural Network (CNN) Architecture

D. VGG16

VGG16 is a widely used convolutional neural network (CNN) architecture for image classification tasks, originally developed for the ImageNet Large Scale Visual Recognition Challenge. It consists of 16 layers, including 13 convolutional layers and 3 fully connected layers. VGG16's deep architecture allows it to learn hierarchical representations of features from input images, capturing intricate patterns and structures. One of the key advantages of VGG16 is its simplicity and uniformity in architecture, with small 3x3 convolutional filters and max-pooling layers. Transfer learning with VGG16 involves initializing the model with pre-trained weights and then fine-tuning it on the MRI dataset. By leveraging knowledge learned from diverse image domains, VGG16 can expedite model training and potentially improve detection performance. Its effectiveness in feature extraction and classification makes VGG16 a valuable asset in developing accurate and robust diagnostic tools for Alzheimer's disease.

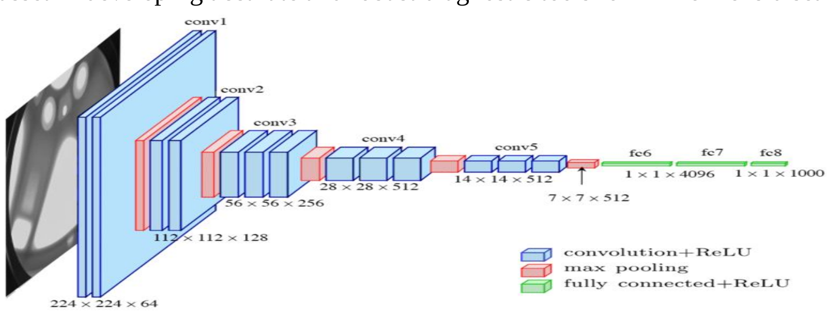


Fig. 2. VGG16 Architecture

E. MobileNet

MobileNet is a lightweight convolutional neural network (CNN) architecture designed for efficient deployment on resource-constrained devices such as mobile phones and embedded systems. It utilizes depthwise separable convolutions to reduce computational complexity while maintaining high accuracy. MobileNet achieves a good balance between model size and performance, making it well-suited for applications where computational resources are limited. One of the key advantages of MobileNet is its small model size, which allows for faster inference and reduced memory footprint compared to larger CNN architectures. This compact design enables efficient deployment of deep learning models for Alzheimer's disease detection on edge devices or in low-resource settings. Transfer learning with MobileNet involves fine-tuning the pre-trained model on MRI datasets, leveraging its learned features to improve detection accuracy while minimizing computational overhead. MobileNet's efficiency and effectiveness in feature extraction make it a promising candidate for developing accessible and scalable diagnostic solutions for Alzheimer's disease.

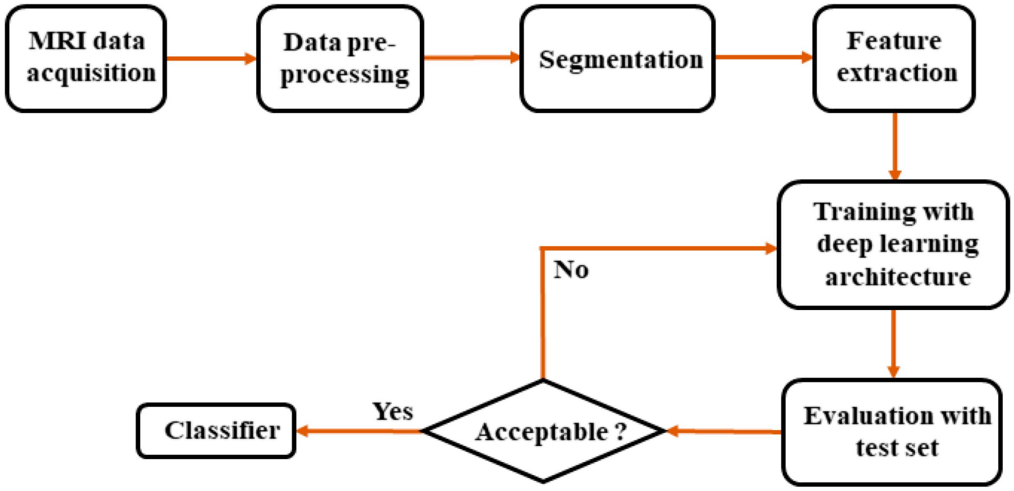
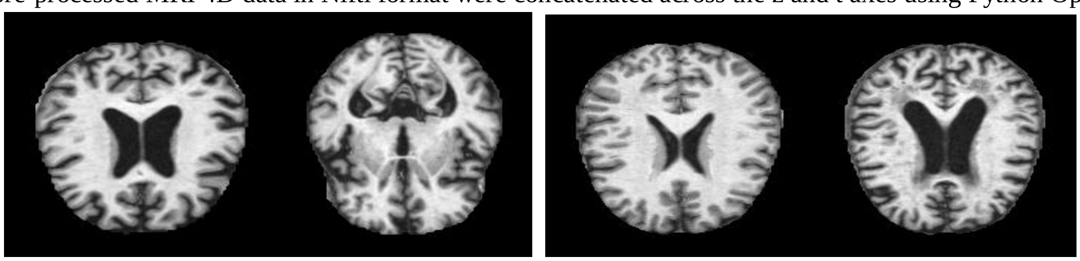


Fig. . Flow Of Operation

IV. RESULTS AND DISCUSSIONS

Deep Learning approaches mainly use the AE, DNN, DBN, and 2D/3D CNN algorithms. In order to create a stack of 2D images in JPEG, the pre-processed MRI 4D data in Nifti format were concatenated across the z and t axes using Python OpenCV.



Mild demented Moderate demented Non demented Very mild demented

Fig. 4. Classified Output of the Alzheimer's disease dataset

The system's accuracy is calculated using the formula below.

Accuracy= (TP+TN)/ (TN+FP+FN+TP), Area under the curve is calculated with false positive rate and true positive rate.

V. FUTURE WORK

This can be utilized in the future to classify the types of different classifications easily which is easy to find out the infections in initial stages and can be cured in the initial stages only.

VI. CONCLUSION

In this project we have successfully classified the MRI images of a person, as either Mild Demented or Moderate Demented or Non-Demented or Very Mild Demented using deep learning algorithms. Here, we have considered the dataset of MRI images which will be of 4 different types and trained using Modified CNN with MobileNet, and VGG16 algorithms. After the training, we tested by uploading the image and classified it.

VII. ACKNOWLEDGEMENT

It is nature and inevitable that the thoughts and ideas of other people tend to drift in to the subconscious due to various human parameters, where one feels acknowledge the help and guidance derived from others. We acknowledge each of those who have contributed for the fulfilment of this project. We take the opportunity to express our sincere gratitude to our guide, whose guidance from time to time helped us to complete this project successfully.

REFERENCES

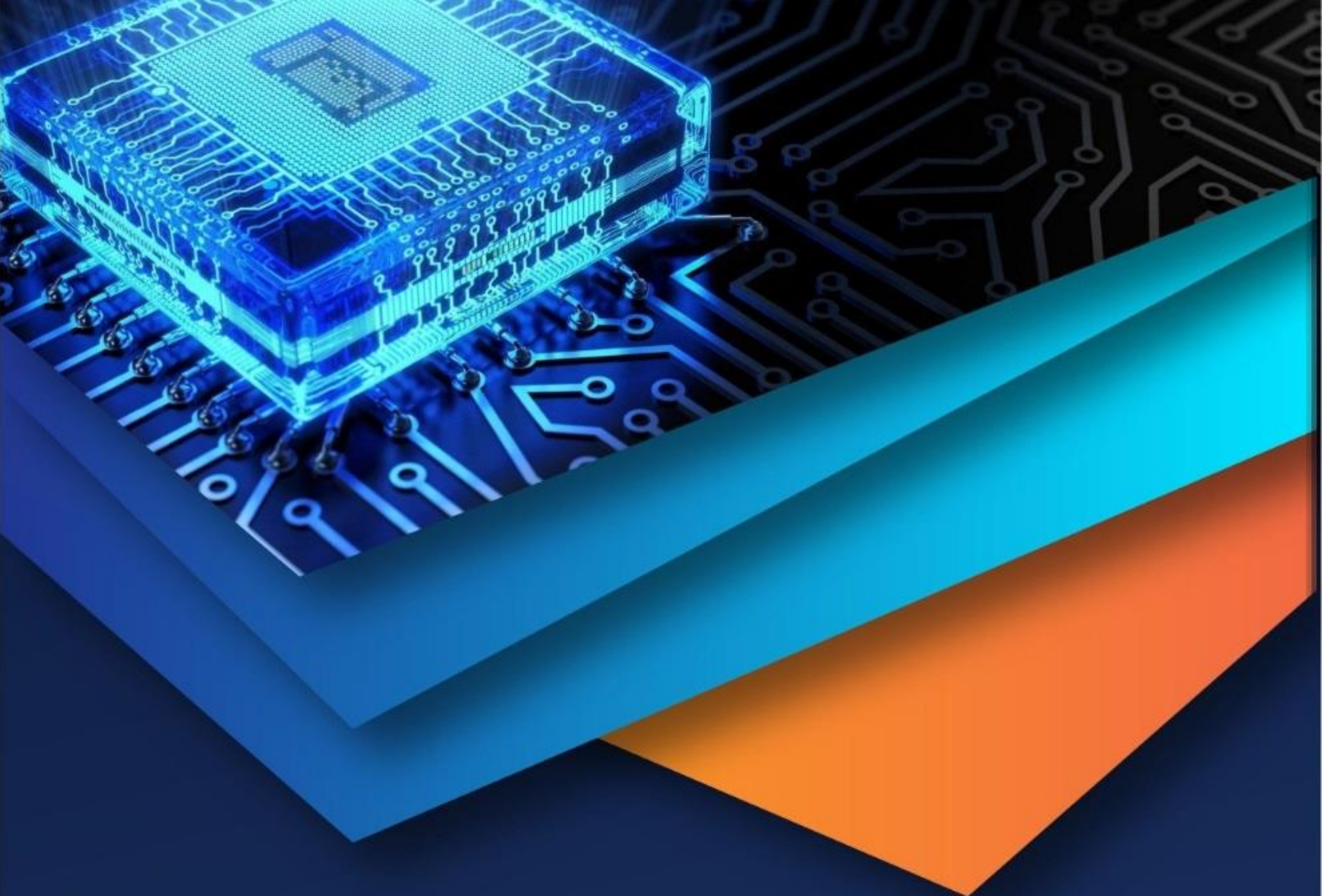
[1] Anh Tuan Tran, The Bao Pham, Jin Young Kim & João Manuel R. S. Tavares on "Alzheimer's diagnosis using deep learning in segmenting and classifying 3D brain MR images". Int J International Journal of Neuroscience

[2] M.A. Ebrahimighahnavieh, S. Luo and R. Chiong on "Deep learning to detect Alzheimer's disease from neuroimaging: A systematic literature review". Int J Computer Methods and Programs in Biomedicine 187 (2020).

[3] Hosseini-asl, R. Keynton, A. El-baz on "Alzheimer's disease diagnostics by adaptation of 3D convolutional network", Electrical and Computer Engineering Department, University of Louisville, Louisville, KY, USA, Proc. - Int Conf Image Process.

[4] Arvindhan, M., D. Rajeshkumar, and Anupam Lakhan Pal. "A Review of Challenges and Opportunities in Machine Learning for Healthcare." Exploratory Data Analytics for Healthcare (2021): 67-84

[5] D. Impedovo, G. Pirlo, G. Vessio et al. on "A Handwriting Based Protocol for Assessing Neurodegenerative Dementia". Cogn Comput 11, 576–586 (2019).



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