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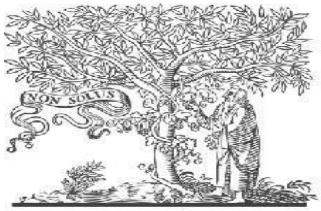

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IJIEMR Transactions, online available on 10th Apr 2023. Link :http://www.ijiemr.org/downloads.php?vol=Volume-12&issue=Issue 04

10.48047/IJIEMR/V12/ISSUE 04/87

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Volume 12, ISSUE 04, Pages: 712-720

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ALZHEIMER'S DISEASE DETECTION USING MACHINE LEARNING

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Abstract

The aim of this paper is to provide an overview of how machine learning can be applied to detect Alzheimer's disease. Specifically, deep learning techniques such as CNN, Mobile Net, and VGG16 are used to achieve maximum efficiency in analyzing MRI scans provided by the user. The paper also addresses the challenges and limitations of using machine learning for Alzheimer's disease detection, such as the lack of standardized datasets and the need for large datasets, as well as the importance of selecting appropriate machine learning models. Alzheimer's disease is a chronic neurodegenerative disorder that primarily affects memory and behavior, and this project offers a promising tool for detecting the disease by identifying patterns in various datasets and determining the stage of the disease. The final output is classified into four stages, namely mild dementia, no dementia, semi-mild dementia, and dementia, which helps users determine appropriate medication based on the output obtained.

Keywords: Datasets, MobileNet, VGG16, Dementia, Alzheimer disease detection, CNN, Machine Learning.

Introduction

Alzheimer's disease is a neurodegenerative disorder that causes a gradual decline in cognitive function, including memory, thinking, and behavioural skills. Early detection is crucial for effective management and treatment, as the disease is progressive and irreversible. Machine learning algorithms have proven to be effective in analysing large datasets and identifying patterns that are difficult for humans to discern. This disease affects a significant portion of the global population and is categorized as a form of dementia that impairs memory, thinking, and behaviour. Recent advancements in machine learning techniques and the availability of large datasets have led to increased attention on the use of machine learning algorithms for Alzheimer's disease detection,

particularly in neuroimaging data. Deep learning techniques such as CNN, MobileNet, and VGG16 are employed in this project to analyse MRI and PET scans and identify biomarkers and features associated with Alzheimer's disease. The objective of this project is to develop accurate and reliable machine learning models that can detect the disease at an early stage. Early detection provides an opportunity for early intervention, which can slow the progression of the disease and improve the quality of life of patients.

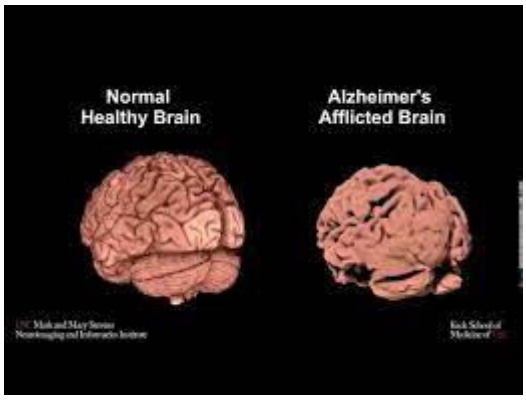

Fig.1. Description

Deep learning concept:

Deep learning is a machine learning and artificial intelligence subfield that has shown great promise in medical image analysis and is capable of addressing various issues in multiple domains. It uses deep neural networks as models with neurons acting as fundamental computational units in the network. These networks are inspired by the functionality of neurons in the human brain and typically consist of an input layer, a hidden layer, and an output layer, with nodes used for data analysis and learning. Pattern detection accuracy is improved by increasing the number of hidden layers in the neural network. Deep learning employs labeled datasets for creating classifiers that predict Alzheimer's disease automatically. The neural network combines multiple input signals linearly, applies weights, and passes them through non-linear operations to produce outputs. Figure 1 illustrates a general neural network representation.

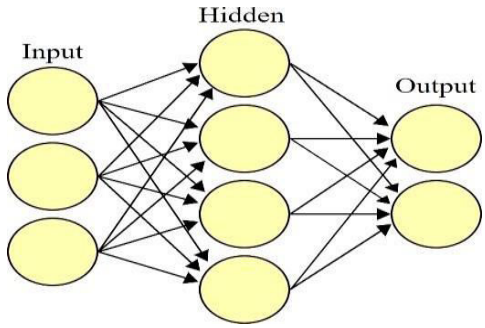

Fig 2. General view of neural network architecture

The use of deep learning algorithms in computer-aided detection and diagnosis allows for the incorporation of multiple architectures and the manipulation of various hyperparameters, resulting in a flexible approach. Medical professionals can benefit from the interpretation of medical images and the identification of features, as well as reduced interpretation time. Multi-modal neuroimaging data is particularly useful in achieving better performance and promising results in the diagnostic classification of Alzheimer's disease.

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Deep learning methods:

Researchers in the field of AD diagnosis have employed a plethora of deep neural network algorithms, which have proven to be more effective than conventional data analysis and learning tools. Deep learning utilizes various neural network architectures-

A. Convolutional neural network (CNN)

The CNN is a popular artificial neural network utilized for classification tasks in image and audio recognition. It excels at handling two-dimensional data and is composed of an input layer, output layer, and hidden layer with multiple convolution, pooling, normalization, and fully connected operations. Figure 3 illustrates a CNN architecture. Compared to other deep learning models, CNN is fast and efficient in machine learning. Its capacity to analyze vast datasets can significantly enhance result accuracy.

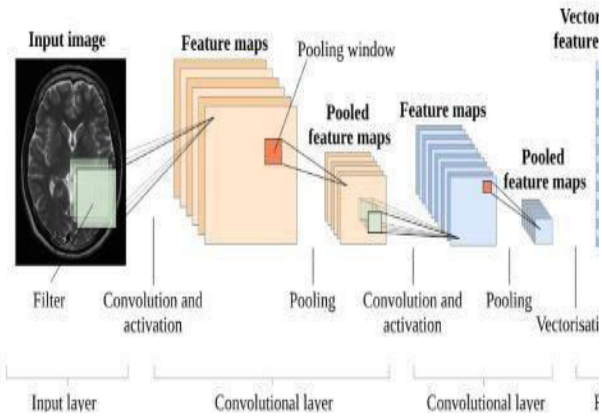

Fig 3. Architecture of convolutional neural network using medical image

B. MOBILENET:

MobileNet is a convolutional neural network architecture that is specifically designed for efficient mobile vision applications. It uses depth wise separable convolutions that separate the spatial convolution and the channel-wise convolution into two separate layers, which reduces the computational cost of the network while still maintaining its accuracy. Compared to other convolutional neural network architectures, MobileNet has fewer parameters and a lower computational cost, which makes it an attractive choice for various applications such as image segmentation and object detection. The network can also be scaled up or down in size using a "width multiplier" parameter, which makes it highly adaptable to different computational resources.

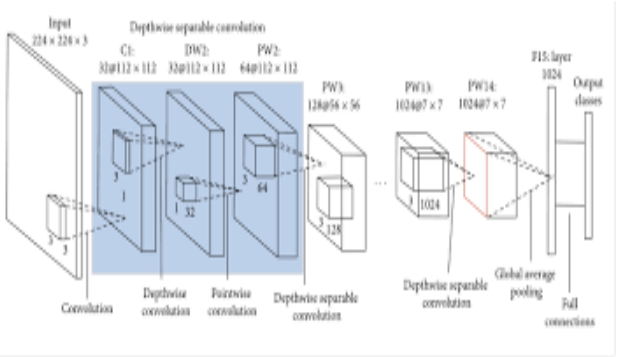

Fig 4. Architecture of MOBILENET

C. VGG16: -

VGG16, a convolutional neural network (CNN) architecture that was developed by the Visual Geometry Group (VGG) at the University of Oxford, is widely used in computer vision research for image classification tasks. The network consists of 16 layers, including 13 convolutional

layers with small 3x3 filters that stack on top of each other to form deep representations of the input image, and 3 fully connected layers for final image classification. VGG16's uniformity and simplicity in architecture have made it a popular standard for comparing the performance of other CNN architectures, and it has demonstrated state-of-the-art performance in numerous image classification tasks, including the ImageNet.

In 2014, the Large Scale Visual Recognition Challenge (ILSVRC) took place.

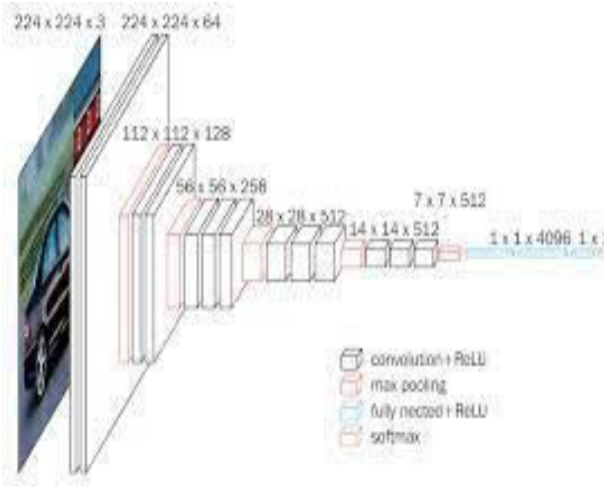

Fig 5. Architecture of VGG16

LITERATURE SURVEY

This section provides a summary of various research papers on the use of deep learning for the classification and diagnosis of Alzheimer's disease (AD) and mild cognitive impairment (MIC). These papers include studies proposing automated AD detection systems using convolutional neural network (CNN) models to analyze MRI scans, reviews of recent advances in machine learning techniques for early detection of AD and for AD diagnosis and prognosis, and literature surveys focused specifically on the use of machine learning algorithms in neuroimaging for AD detection and diagnosis, as well as the prediction of the onset of AD in at-risk individuals.

1. "Automated Alzheimer's Disease Detection Using Deep Learning" (2021) by Alkharabsheh et al.: This study proposed an automated AD detection system using a convolutional neural network (CNN) model to analyze magnetic resonance imaging (MRI) scans. The model achieved an accuracy of 94.3% in AD detection.

2. "Detection of Alzheimer's Disease from MRI using Convolutional Neural Networks" (2019) by Qayyum et al.: This study proposed a CNN-based approach for AD detection from MRI scans. The model achieved an accuracy of 91.67% in AD classification.

3. "Machine Learning Approaches for Early Detection of Alzheimer's Disease" (2019) by Wijesinghe et al.: This study reviewed the recent advances in machine learning techniques for early detection of AD. It highlighted the potential of machine learning algorithms in identifying early biomarkers of AD.

4. "Early Detection of Alzheimer's Disease using Machine Learning Techniques: A Review" (2018) by Kaur and Sidhu: This study reviewed the recent developments in machine learning techniques for AD detection. It discussed the strengths and limitations of different machine learning algorithms used in AD diagnosis.

5. "A Deep Learning Approach for Alzheimer's disease Detection using MRI Images" (2017) by Sarraf and Tofighi:
This study proposed a deep learning approach for AD detection using MRI Images".

6. "Machine learning in Alzheimer's disease diagnosis and prognosis" by Feng Shi, Jingwen Yan, et al. This literature survey provides a comprehensive review of recent studies that have applied machine learning algorithms to different types of data for AD diagnosis and prognosis.

7. "A comprehensive review on machine learning approaches for Alzheimer's disease classification" by Asmaa Abbas, Musaed Alhussein, et al. This literature survey reviews recent studies that have used various machine learning techniques for AD classification using different types of data.

8. "Machine learning in neuroimaging: a survey focused on Alzheimer's disease" by Gloria Castellazzi, Sabina Tangaro, et al. This literature survey focuses specifically on the use of machine learning algorithms in neuroimaging for AD detection and diagnosis.

9." Machine learning techniques for early prediction of Alzheimer's disease: a review" by Karma Awada, Ali Al-Assaad, et al. This literature survey provides an overview of recent studies that have used machine learning algorithms to predict the onset of AD in individuals who are at risk of developing the disease.

10. "A review of machine learning techniques for diagnosis and prognosis of Alzheimer's disease" by Raju Vaishya, Abhishek Sharma, et al. This literature survey provides a comprehensive review of recent studies that have used machine learning algorithms for both AD diagnosis and prognosis.

Problem statement

1) How do I start a web page to diagnosis of Alzheimer's disease using MRI scan?

2) How do ML Diagnosis images?

Machine learning has the potential to aid in early detection and diagnosis of Alzheimer's disease using various biomarkers, including brain imaging and genetic data. However, current machine learning models often lack accuracy and interpretability, hindering their clinical utility. This study aims to develop a more accurate and interpretable machine learning model for the early detection and diagnosis of Alzheimer's disease using a combination of brain imaging and genetic data.

Methodology

Convolutional Neural Network (CNN) Deep learning algorithm known as Convolutional Neural Network (CNN) is primarily employed for image and video analysis. Applying filters or kernels to the input photos enables it to learn spatial hierarchies of features automatically and adaptively. Convolutional layers process the features that these filters extract from the images, such as edges, lines, shapes, and textures. Because they can learn from large datasets and extract important

features from images, CNNs do far better than conventional machine learning algorithms at image classification, object detection, and recognition tasks.

The following are the Convolutional neural network algorithmic steps:

1. Input Image: The input image is fed into the network. The image can be preprocessed to adjust its size and colour space.
2. Convolutional Layers: The convolutional layer is responsible for extracting features from the input image. Each convolutional layer applies a set of filters to the input image to produce a set of feature maps.
3. Activation Function: An activation function is applied to each feature map to introduce nonlinearity into the model.
4. Pooling Layers: The pooling layers down sample the feature maps to reduce the spatial dimensionality and make the model more computationally efficient.
5. Fully Connected Layers: The fully connected layers take the flattened output from the convolutional and pooling layers and perform a series of linear transformations to produce the final output. These layers are often used for classification or regression tasks.
6. Output: The final output is produced by the fully connected layers. For classification tasks, a SoftMax function is often applied to the output to produce a probability distribution over the classes.
7. Loss Function: A loss function is used to measure the error between the predicted output and the true output. The loss is then backpropagated through the network to update the weights and biases.
8. Optimization Algorithm: An optimization algorithm, such as Adam or SGD, is used to minimize the loss function by adjusting the weights and biases of the network.

Repeat: Steps 1-8 are repeated for multiple epochs until the model converges to a satisfactory solution.

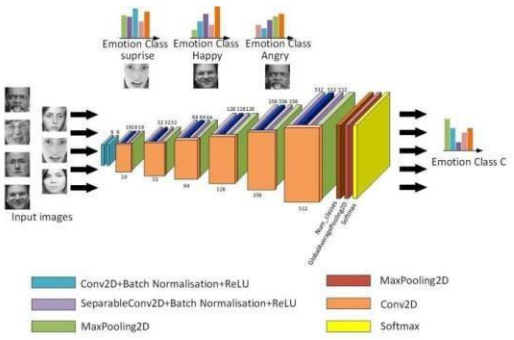

Fig 6. Architecture of convolutional neural network using medical image

Implementation

1.Preprocessing

Preprocessing: Preprocessing is an important step in preparing data for use in a CNN. Common preprocessing techniques include resizing, normalization, and data augmentation. Resizing is used to ensure that all input images are the same size, which is important for efficient computation. Normalization is used to scale pixel values so that they fall within a certain range, often

between 0 and 1, to make training more stable. Data augmentation is used to increase the size of the dataset by applying transformations such as rotation, scaling, and flipping to the input images.

2.Feature extraction:

The technique of automatically extracting valuable features from raw input data is known as feature extraction in CNNs. Convolutional layers are frequently used for this, which apply a series of filters to the input data and produce feature maps that record the existence of particular features.

3.Dataset

Dataset: While developing a CNN, the dataset you use is a crucial factor. The dataset should be representative of the intended task and contain a sufficient number of examples to train the network properly. Alzheimer's disease detection dataset was obtained from Kaggle. It has 7k images and 7 captions for each one. It has 7000 distinct images, each of which will correspond to four different types of stages involved in Alzheimer's disease detection.

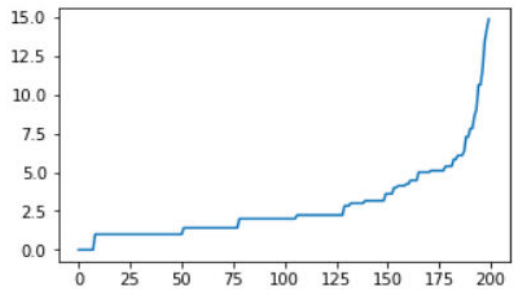

Fig.1. Description

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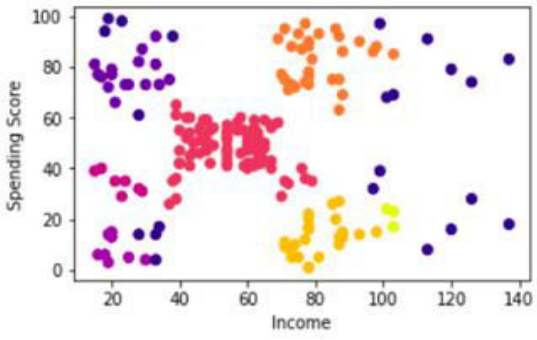

Fig.2. Description

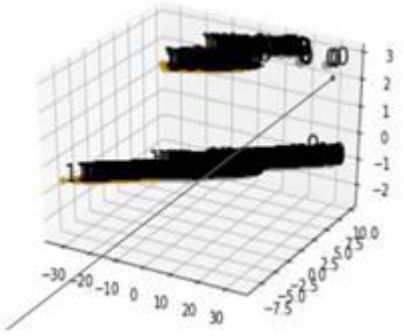

Fig.3. Description

Conclusion and FutureScope

In this article, We concluded that machine learning has shown promising results in detection Alzheimer's disease using various data sources such as brain images. Machine learning algorithms have been used to develop productive models that can accurately identify individuals at risk of developing Alzheimer's disease, differentiate between Alzhiemer's disease and other forms of dementia, and perfect disease progression. However, there are still challenges that need to be addressed before machine learning can be widelyu used in clinical practice for Alzheimer's disease detection. These challenges include the need for large and diverse datasets, standardized data bcollection and preprocessing procedures, and the development of interpretable and

explainable machine learning models. Despite these challenges, the potential of ML in Alzheimer's disease detection is exciting and offers hope for earlier and more accurate diagnosis, which could lead to a better treatment and care for patients.

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