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Alzheimer’s Diseases Detection by Using Deep Learning Algorithm

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ABSTRACT_ When the disease is still in its early stages, an accurate diagnosis of Alzheimer's disease (AD) is crucial for patient treatment because it enables patients to take precautions before irreversible brain damage occurs. Although computers have been used to diagnose AD in many recent studies, the majority of machine detection techniques are constrained by congenital observations. AD can be identified in its early stages, but it cannot be predicted because prediction is only useful before the disease appears. A common method for the early diagnosis of AD is deep learning (DL). Here, we briefly review some of the key works on AD and consider how DL can aid in the early detection of the disease by researchers.

1.INTRODUCTION

Alzheimer's disease (AD) accounts for 60–80% of dementia cases, making it the most common cause [1, 2]. Mild cognitive impairment (MCI) is the initial sign of AD, a neurodegenerative form of dementia, which gradually gets worse. It affects brain cells, causes memory loss, impairs thinking, and prevents simple tasks from being completed [3, 4]. As a result, AD is a progressive neurological brain disease with multiple facets. People with MCI are more likely than others to develop AD [5, 6]. Because it begins at least two decades before symptoms are noticed, AD affects people only after years of brain changes. According to Alzheimer's disease International (ADI), the condition affects more than 50 million people worldwide. This percentage is expected to rise to 152 million people by 2050, or one person with dementia every three seconds. The cost of dementia is estimated to be $1 trillion annually and will double by 2030 [7]. The proportion of people with Alzheimer's disease varies by age. In 2020, there will be 5.8 million Americans over 65 with AD, as shown in Figure 1. Furthermore, by 2050, it is normal to arrive at 13.8 million [5]. Experts in the field of Alzheimer's disease face the greatest obstacle: there is currently no effective treatment for AD [8, 9]. Despite this, current AD treatments can alleviate or halt symptoms progression. In this way, the early discovery of Promotion at its prodromal stage is basic [10, 11]. PC Supported Framework (computer aided design) is utilized for precise and early Promotion discovery to stay away from Promotion patients' high consideration costs, which are supposed to rise emphatically [12]. Both voxel-based features and region of interest (ROI)-based features are typically utilized by conventional machine learning methods in the early diagnosis of AD [13]. In particular, they rely heavily on fundamental assumptions regarding structural or functional anomalies in the brain, such as regional cortical thickness, hippocampal volume, and gray matter volume [14, 15]. Manual feature extraction is the foundation of traditional approaches. This method seems to take a long time and is subjective because it requires a lot of technical knowledge and repeated attempts. Consequently, convolutional neural networks (CNNs) and deep learning are effective solutions to these issues [16]. CNN's ability to automatically extract features eliminates the need for manual feature extraction, which increases its efficacy and has demonstrated great success in AD diagnosis [17, 18].

2.1 Ali H. Al-nuaimi et.al "Changes in the EEG Amplitude as a Biomarker for Early Detection of Alzheimer's Disease",2016 30th Annual International Conference of the IEEE Engineering in Medicine and Biology society (EMBC).

The rapid increase in the number of older people with Alzheimer's disease (AD) and other forms of dementia represents one of the major challenges to the health and social care systems. Early detection of AD makes it possible for patients to access appropriate services and to benefit from new treatments and therapies, as and when they become available. The onset of AD starts many years before the clinical symptoms become clear. A biomarker that can measure the brain changes in this period would be useful for early diagnosis of AD. Potentially, the electroencephalogram (EEG) can play a valuable role in early detection of AD. Damage in the brain due to AD leads to changes in the information processing activity of the brain and the EEG which can be quantified as a biomarker. The objective of the study reported in this paper is to develop robust EEG-based biomarkers for detecting AD in its early stages. We present a new approach to quantify the slowing of the EEG, one of the most consistent features at different stages of dementia, based on changes in the EEG amplitudes (ΔEEGA). The new approach has sensitivity and specificity values of 100% and 88.88%, respectively, and outperformed the Lempel-Ziv Complexity (LZC) approach in discriminating between AD and normal subjects.

2.2 Jiehui Jiang et.al "A Computed Aided Diagnosis tool for Alzheimer's Disease based on 11C-PiB PET imaging technique", IEEE International Conference on Information and Automation Lijiang, China, August 2015

Pittsburgh compound B Positron Emission Tomography (PiB PET) imaging is a new technique to detect amyloid-beta (Aβ). Aβ is a pathological bio-data which appears distinctly in most neuro-degeneration diseases, such as Alzheimer's disease (AD). Although PiB PET imaging is relative mature, the accurate diagnosis of AD based on PiB PET images still remains a challenge for radiologists. To solve above problem, this paper proposes a Computed Aided Diagnosis (CAD) tool, which combines three machine learning

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kernels: Principal Component Analysis (PCA), Independent Component analysis (ICA) and Support Vector Machine (SVM). The experimental results with 120 groups of PiB PET images showed that the proposed CAD tool can yield a high accuracy in AD diagnosis.

3.PROPOSED WORK

In this study, we proposed an intelligent methodology for building a convolutional neural network (CNN) from scratch to detect AD stages from the brain MRI images dataset and to improve patient care. It is worth mentioning that training a deep-learning model requires a large amount of data to produce accurate results and prevent the model from overfitting problems. Therefore, for better understanding of classifiers and to overcome the model overfitting problem, we applied data augmentation to the minority classes in order to increase the number of MRI images in the dataset. All experiments were conducted using Alzheimer’s MRI dataset consisting of brain MRI scanned images. The performance of the proposedmodel determines detection of the four stages of AD. Experimental results show high performance of the proposed model in that the model achieved a 99.38% accuracy rate, which is the highest so far.

3.1 IMPLEMENTATION

Upload Image: we collect the dataset from Kaggle website in that dataset we have Mild Demented , Moderate Demented , Non Demented, VeryMild Demented classes.

Image Pre-Processing: after collecting the dataset we have to filter the dataset like removing unnecessary data and resizing the images, converting the images into array format.

Model Load: we have to train the dataset for vgg16 algorithm, for training we have to divide the dataset into two parts training and testing, training will train the algorithm testing will test the algorithm finally gives the accuracy

Prediction: we have to test the uploaded image with trained algorithm to get the result.

3.2 CNN ALGORITHM

Deep Learning is turning into a very famous subset of laptop studying due to its excessive degree of overall performance throughout many sorts of data. A amazing way to use deep gaining knowledge of to classify pix is to construct a Convolutional Neural Network (CNN). The Keras library in Python makes it extraordinarily easy to construct a CNN. Computers see pictures the usage of pixels. Pixels in pix are typically related. For example, a sure team of pixels may additionally signify an part in an photograph or some different pattern. Convolutions use this to assist become aware of images. A Convolution multiplies a matrix of pixels with a filter matrix or kernel and sums up the multiplication values. Then the convolution slides over to the subsequent pixel and repeats the identical technique till all the photograph pixels have been covered.

Convolutional Neural Networks are very comparable to everyday Neural Networks; they are made up of neurons that have learnable weights and biases. Each neuron receives some inputs, performs a dot product and optionally follows it with a non-linearity.

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Regular Neural Nets don't scale nicely to full images. Consider a picture of measurement 32x32x3(32 wide, 32 high, three colour channels), so a single utterly related neuron in a first hidden layer of a everyday Neural Network would have 32*32*3 = 3072 weights. This quantity nevertheless appears manageable, however simply this completely linked shape does no longer scale to large images. For example, an photo of extra first rate size, e.g.200x200x3, would lead to neurons that have200*200*3 = 120,000 weights. Moreover, all of us desire to have numerous such neurons, so the parameters would add up quickly! Clearly, this full connectivity is wasteful and the massive variety of parameters would rapidly lead to overfitting.

Convolutional Neural Networks take gain of the truth that the enter consists of snap shots and they constraint the structure in a greater good way. In particular, not like a ordinary Neural Network, the layers of a ConvNet have neurons organized in three dimensions:width, height, depth. For example, the enter photograph with dimensions XxYxZ (width, height, depth respectively), the neurons in a layer will solely be linked to a small vicinity of the layer earlier than it, rather of all of the neurons in a fully-connected manner, the remaining output layer would have dimensions(1,1,C), because with the aid of the quit of the ConvNet architecture, it will limit the full photo into a single vector of category scores, organized alongside the depth dimension.

3.2.1 Layers in Convolutional Neural Network

• The convolutional layer will compute the output of neurons that are linked to local regions in the input, with each neuron computing a dot product between their weights and a small region in the input volume to which they are reconnected.

• At zero, the RELU layer will use an element-wise activation function, such as the max(0,x) thresholding.

• The POOL layer will undertake down sampling along the spatial dimensions (width, height).

• The FULLY linked layer will compute the class scores, producing in a volume of size [1x1xX], where X integers correspond to class scores.

3.2.2 Convolution layer

When dealing with excessive dimensional inputs such as images, as considered above it is impractical to join neurons to all neurons in the preceding volume. Instead, it will join every neuron to solely a nearby location of the enter volume. The spatial extent of this connectivity is a hyperparameter referred to as the receptive discipline of the neuron(equivalently this is the filter size).

The extent of the connectivity alongside the depth axis is usually equal to the depth of the enter volume. It is vital to emphasize once more this asymmetry in how to deal with the spatial dimensions(width and height) and the depth dimension: The connections are

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nearby in house (along width and height), however constantly full alongside the complete depth of the enter volume.

Example 1. For example, believe that the enter extent has dimension [32x32x3], (e.g.anRGBCIFAR-10image).If the receptive field(or the filter size)is5x5,then every neuron in the Convolution Layer will have weights to a [5x5x3] vicinity in the enter volume, for a whole of 5*5*3 =75 weights (and +1 bias parameter). Notice that the extent of the connectivity alongside the depth axis ought to be 3, due to the fact that this is the depth of the enter volume.

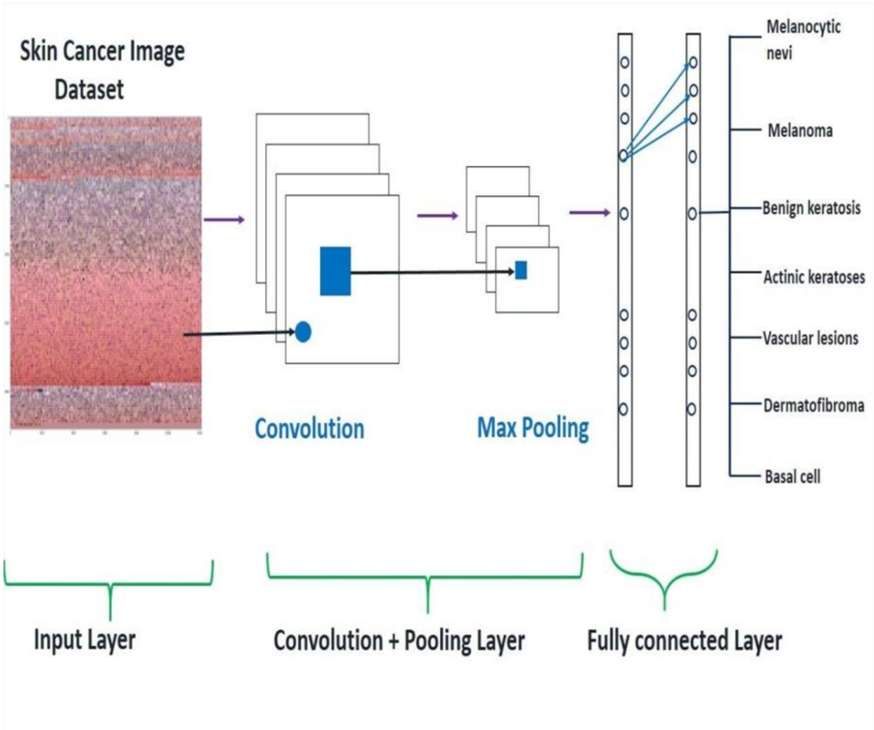

Fig 1: Convolutional- layer representation

An example red input volume (e.g., a 32x32x3 CIFAR-10 image) and an example volume of neurons in the first Convolutional layer are shown on the left. Each neuron in the Convolutional layer is spatially related only to a tiny region in the input volume, but to the entire depth (i.e., all colour channels). It should be noted that there are several neurons (5 in this case) along the depth, all of which are staring at the same place in the input.

Right: The neurons from the Neural Network chapter are unaltered: They still calculate a dot product of their weights with the input, followed by a nonlinearity, but their connectedness is now spatially limited to be local. 1) Convolutional Layer: In a typical neural network each input neuron is connected to the next hidden layer. In CNN, only a small region of the input layer neurons connect to the neuron hidden layer.

2)Relu Layer:- In this layer we apply activation function.

3) Pooling Layer: The pooling layer is used to reduce the dimensionality of the feature map. There will be multiple activation & pooling layers inside the hidden layer of the CNN.

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4) Fully-Connected layer: Fully Connected Layers form the last few layers in the network. The input to the fully connected layer is the output from the final Pooling or Convolutional Layer, which is flattened and then fed into the fully connected layer.

4.RESULTS AND DISCUSSION

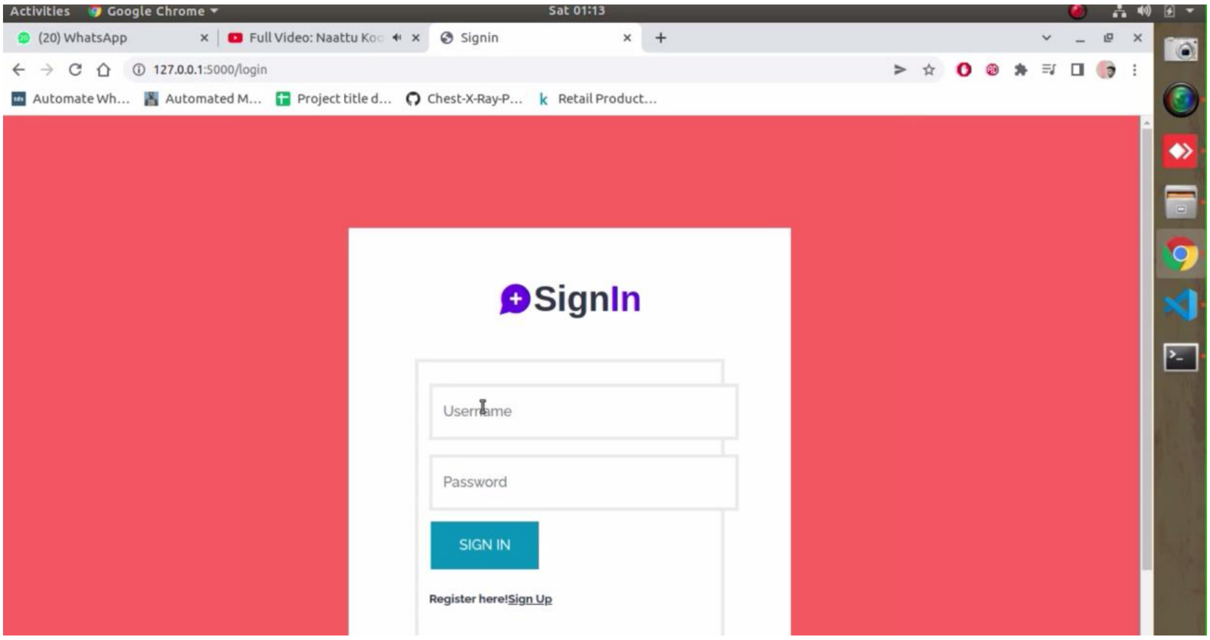

Fig 2:Sign in Page

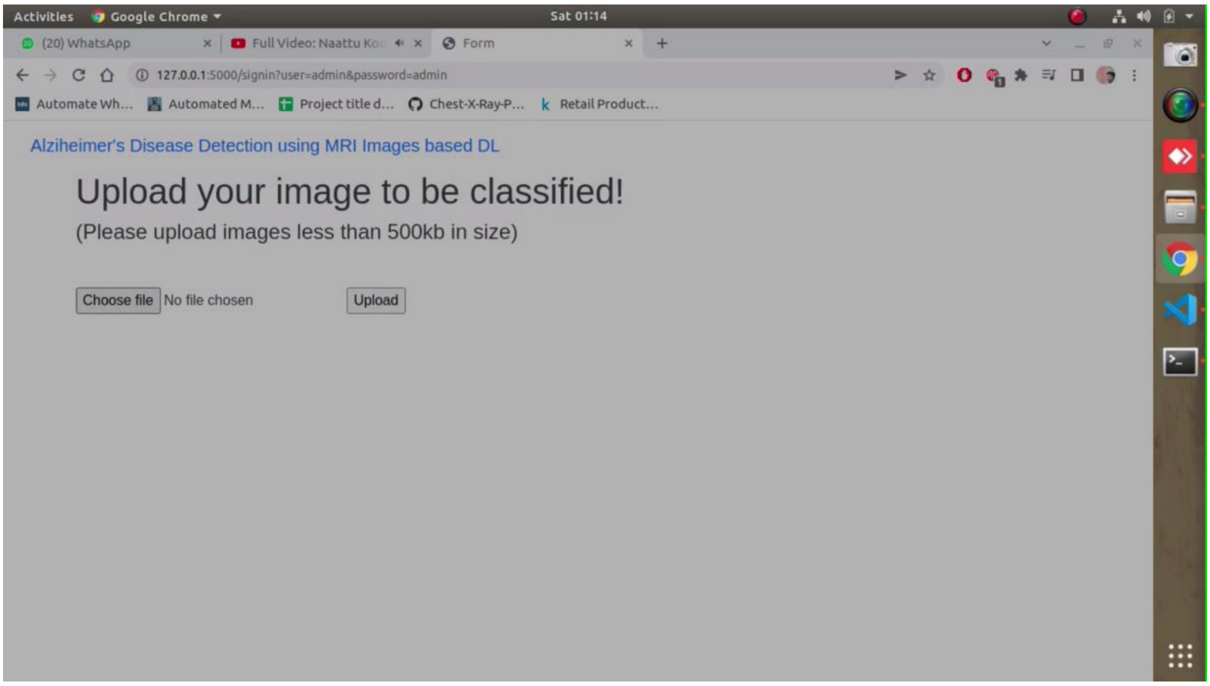

Fig 3:Upload Input Image

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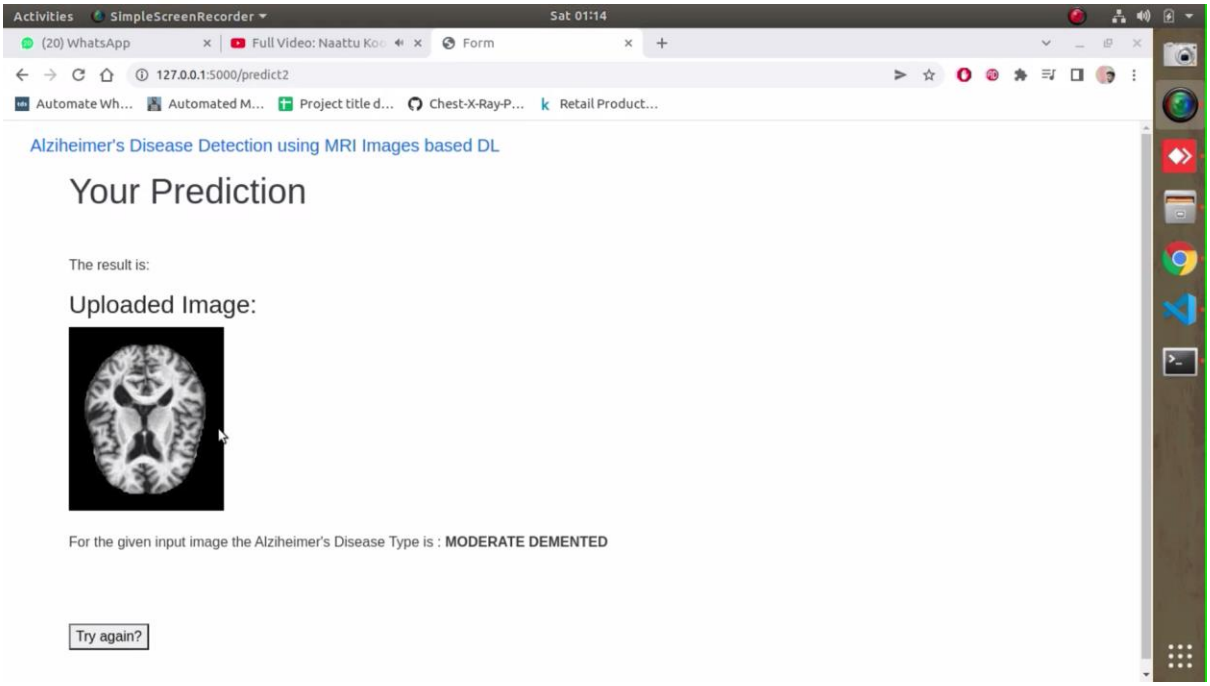

Fig 4:Disease Predicted as MODERATE DEMENTED

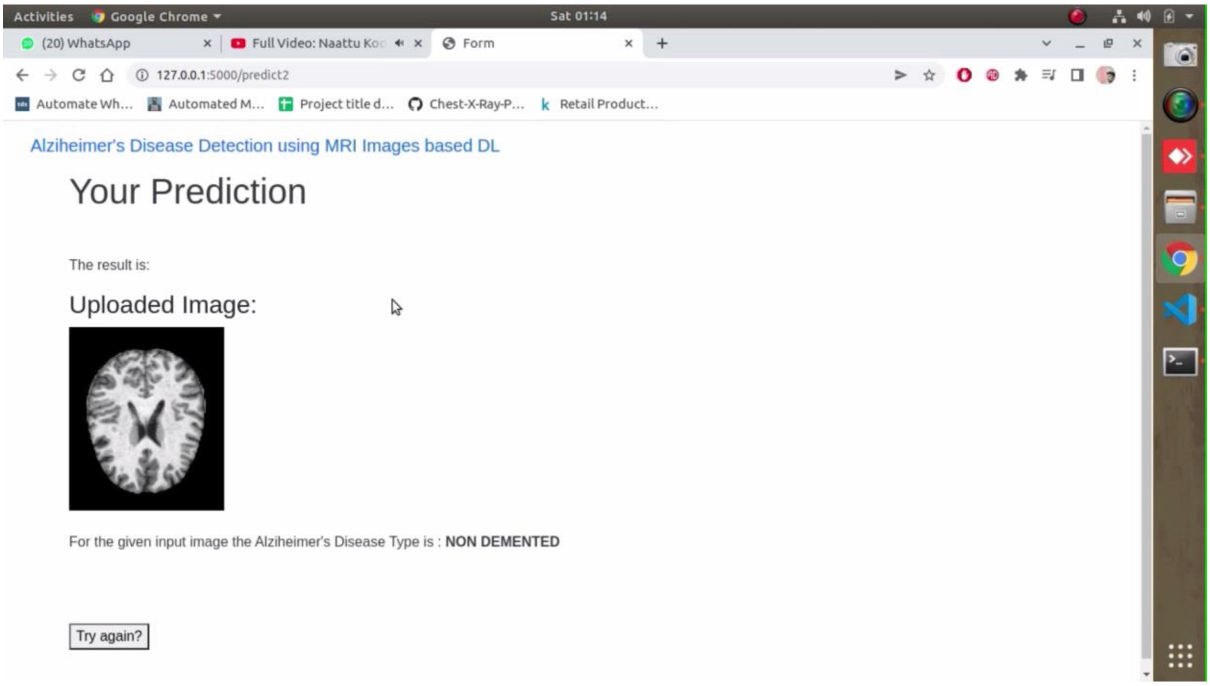

Fig 5:Disease Predicted as NON DEMENTED

5.CONCLUSION

The most common cause of dementia is Alzheimer's disease. A prospective approach to early disease detection is identified in this paper. The images have been successfully classified into the appropriate four classes using the models in this paper, and our findings are indeed encouraging. To ensure that this model can be used in clinical settings and increase the rate of health care for this disease, additional research is required. People should be educated about this disease and encouraged to have their health checked.

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In order to improve its practical application, we are currently working on implementing this model on a website. Later on, this model can likewise be tried on a bigger dataset. For the "Moderate Demented" class, the current dataset contained nearly 300 training and testing sessions. The proposed model has the potential to assist physicians in making more accurate diagnoses of Alzheimer's disease and can be modified to automatically identify other neurodegenerative diseases in the future.

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