Multi Class Alzheimer's Disease Detection Using Deep Learning Technique

Pushpa Bista[1], Mandala Vandana[2], Pinninti Srija Reddy[3], Ragottham Krishna Vamshi[4], Ms.M.Aishwarya[5]
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[1,2,3,4] *Student, Department of Electronics and Communication Engineering, Teegala Krishna Reddy Engineering College*
[5]*Assistant Professor, Department of Electronics and Communication Engineering, Teegala Krishna Reddy Engineering College*

***Abstract*— Alzheimer's disease is the extremely popular cause of dementia that causes memory loss. People who have Alzheimer's disease suffer from a disorder in neurodegenerative which leads to loss in many brain functions. Nowadays researchers prove that early diagnosis of the disease is the most crucial aspect to enhance the care of patients' lives and enhance treatment. Traditional approaches for diagnosis of Alzheimer's disease (AD) suffers from long time with lack both efficiency and the time it takes for learning and training. Lately, deep-learning-based approaches have been considered for the classification of neuroimaging data correlated to AD. In this paper, we study the use of the Convolutional Neural Networks (CNN) in AD early detection, VGG-16 trained on our datasets is used to make feature extractions for the classification process. Experimental work explains the effectiveness of the proposed approach.**

***Index Terms*— Alzheimer's disease, CNN(convolution neural network) , VGG-16**

I. INTRODUCTION

A. ALZHEIMER'S DISEASE :

Alzheimer's disease is a progressive neurologic disorder that causes the brain to shrink (atrophy) and brain cells to die. Alzheimer's disease is the most common cause of dementia — a continuous decline in thinking, behavioral and social skills that affects a person's ability to function independently.

fig 1 Alzheimer's disease

The early signs of the disease include forgetting recent events or conversations. As the disease progresses, a person with Alzheimer's disease will develop severe memory impairment and lose the ability to carry out everyday tasks.

B. PROBLEM FORMULATION AND PROPOSAL:

This study is to introduce the Intelligent Healthcare Prediction and Classification System for AD Based on Deep learning with Big data Analytics. The main objective is to enhance classification accuracy to get the high-performance prediction of disease that helps us for early detection of disease and thus reducing the occurrence of dementia. Many kinds of research still don't achieve high performance of classification so we will seek to improve the accuracy of the model by using Deep Learning. Deep Learning is the most recent technique that allows the machine to distinct representation from raw data. In traditional machine learning technique is required to identify most of the feature by the expert to minimize data complexity and make it more visible for working with a learning algorithm. Unlike Deep Learning algorithms aims to learn high-level features extraction from data. This removes the need for domain expertise.

II. EXPERIMENTAL METHODOLOGY

A. Proposed System:

in this paper, we propose a model to overcome the above limitations. Our proposed CNN model is based on a 12-layer architecture, which consists of convolutional, max pooling, dense, and flatten layers and three activation functions, namely Sigmoid, ReLU, and Leaky ReLU. Our proposed model has been used for binary classification and detection of

Alzheimer's disease. The performance of our proposed model is compared with some existing CNN models that demonstrate the superiority of our proposed model over the existing models. The main contribution of the paper is as follows: 1) A 12-layer CNN architecture, which has achieved an accuracy of 97.75%, which is higher than any other previous studies that have been done before on the OASIS dataset. 2) The performance of our proposed model is better than some pre-trained models, namely InceptionV3, Xception, MobilenetV2, and VGG19.

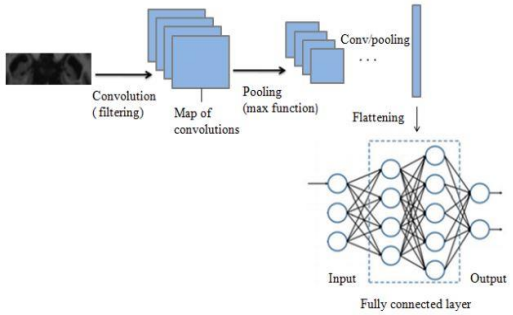

Fig 3 CNN

Our Proposed 12-layer CNN model:

In this section, we discuss our proposed 12-layer CNN model for the detection and classification of Alzheimer's disease using brain MRI images. Our 12-layer CNN model has five steps:

1) Convolutional layer selection: In our proposed CNN model, we used Conv2D. We have used four conv2D layers in our model.

2) Pooling layer selection: In this model, we have used Maxpooling2D. For every Conv2D layer, we have used a Maxpool2D layer. Therefore, we have used four MaxPool2D layers.

3) Flatten Layer: In our model, after using the pooling layer, we used a flatten layer to flatten the whole network.

4) Dense Layer: After the flatten layer, we have used two dense layers. The dense layers are also known as fully connected layers.

5) Activation Function: We have used Sigmoid function as shown in Eq. 1 with another dense layer and ReLU function, as shown in Eq. 2. We have also used a Leaky ReLU activation function as it has proved to give the best performance with Maxpooling2D. The three activation functions are shown as follows.

Demonstrate performance of our proposed model:

In order to analyze the performance of our proposed CNN model, we calculated precision, recall, F1 score, accuracy, and ROC curve. The equations of accuracy, f1-score,

B. Algorithms and Techniques

Three supervised learning approaches are selected for this problem. Care is taken that all these approaches are fundamentally different from each other, so that we can cover as wide an umbrella as possible in term of possible approaches. For example- We will not select Random Forest and Ada Boost together as they come from the same family of 'ensemble'

III. MODELLING ANALYSIS

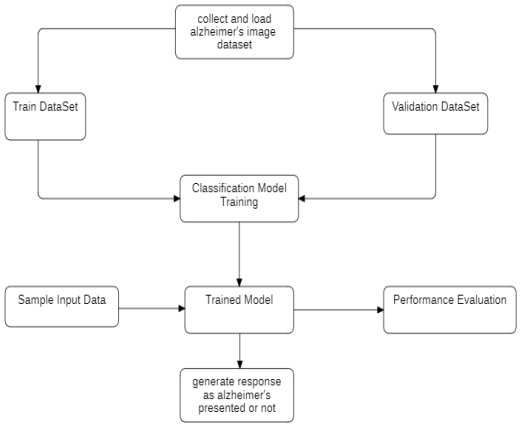

Fig 6 block diagram

At this step the developers decide a roadmap of their plan and try to bring up the best software model suitable for the project. System analysis includes Understanding of software product limitations, learning system related problems or changes to be done in existing systems beforehand, identifying and addressing the impact of project on organization and personnel etc. The project team analyzes the scope of the project and plans the schedule and resources accordingly.

IV. RESULTS AND DISCUSSION

A. Accuracy

A total of 6400 images was used out of which 896 Mild demented, 64 Moderate demented, 3200 Non demented , 2240 very mild demented. We measured the performance of our algorithm using 1013 test

images out of which 139 Mild demented, 10 Moderate demented, 530 Non demented, 334 very mild demented. We obtained an accuracy of 99% on the test data, which is remarkable achievement when compared to existing state of art. VGG16 combined with FASTAI enabled us to give such a good performance for the four way classification of Alzheimer's disease. The confusion metrics was computed as given in the figure 4 using which precision, Recall and F1 score was computed for further analysis of the classification task a given in

For the training process the learning rate of 5e-4 was chosen which helped to attain smooth exponentially decreasing curve for training and validation losses and an exponentially increasing curve for training and testing accuracy as shown in Figure 5. FASTAI helped to finish the training process in very small number of epochs. Selection of 32 size batches also enabled to give good performance of the algorithm. SGD combined with Nestrov Momentum was used as the optimizer which prevented the algorithm from falling into local minimum and converge in lesser number of iterations

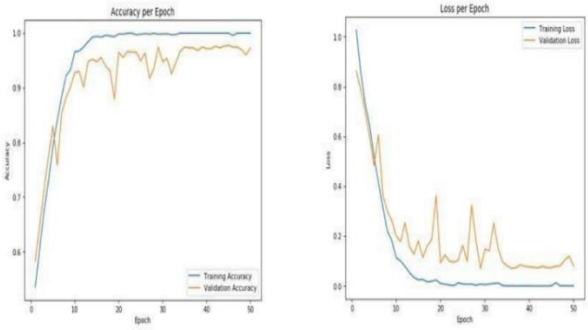

Fig 7 Graph of training and testing accuracy with epochs(loss).

B. flask framework

i)First interface: First interface gives access to folder by providing choose option, where a brain MRI scanned image can be given as input.

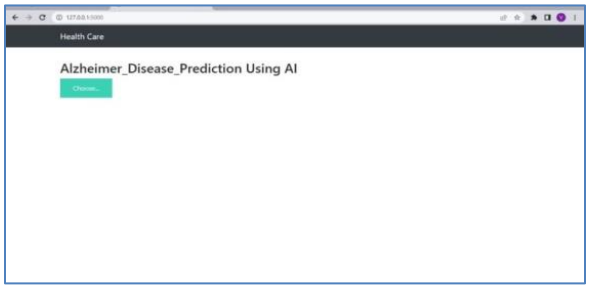

Fig 8 choose interface

ii)Second interface : it provides a interface in which a predict button is provided

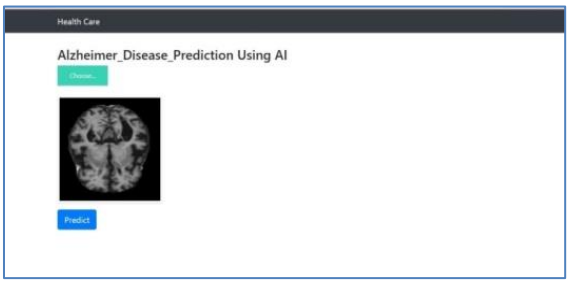

Fig 9 predict interface

iii)Third interface : it shows the result

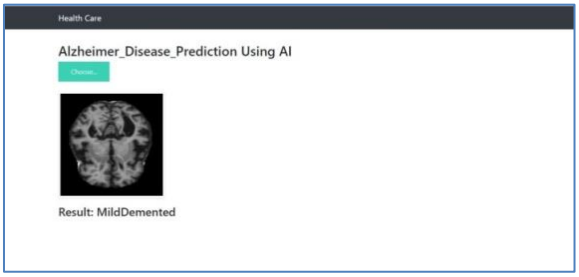

Fig 10 result

V. CONCLUSION

In this paper, we presented a 12-layer CNN model for binary classification and detection of Alzheimer's disease. We performed our study on the OASIS dataset. We used data pre-processing techniques, namely, Image resizing and Image denoising. Our proposed 12-layer CNN model is based on deep learning and machine learning algorithms. Our proposed model performs better than an existing 8-layer CNN model, and four pre-trained CNN models. Our future research plan is to perform multi-class classification on the OASIS dataset and early detection of Alzheimer's disease.

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