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Implementation Paper of Early Detection of Alzheimer's using PET scan

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Abstract – *Alzheimer's disease has become one of the most fatal diseases in recent times. It not only causes the death of the patients but also it leads to people suffering from it a difficult time with their day to day lives. Despite all the medicinal and technological advancements, the diagnosis of Alzheimer's has been sub-par. The main aim of this model is to decorously predict the stage of the disease, the patient is suffering from. This model uses Deep Learning techniques such as CNN(Convolutional Neural Network), ResNet upon which some fine tuning is done to provide us with most suitable model to predict.*

Keywords - *Alzheimer's, PET, Machine learning, feature extraction, data processing*

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I. INTRODUCTION

Alzheimer's disease is one of the deadly neuro degenerative diseases which can only worsen with time if left untreated. It is one of the major causes in 60-70% of dementia. The early indications of Alzheimer's disease are where a person starts to forget things. In some of the advanced cases or as the disease progresses the patient may lose some motor functions, issues in their behavior, have difficulty in understanding or speaking known languages, mood swings and disorientation which means they have the tendency to get lost. As the situation worsens the patients tend to isolate themselves from their family members and society. Soon they might lose control over bodily functions which might finally lead to death. The life expectancy of the patients diagnosed with Alzheimer's maybe from 3-9 months which will again depend upon the progress of degeneration.

The grounds for Alzheimer's disease is understood poorly. There are many risk factors which can be genetic or environmental which can be associated with its advancement. APOE which is an allele is the risk factor which is the strongest. Some other risk factors are injuries to the head, high BP and clinical depression. Alzheimer's disease is also caused due to accumulation of various proteins such as Tau or plaques of amyloid. This might lead to loss of connections between the neurons or as the name suggests the neuron might degrade or destroyed.

Alzheimer's disease might be mistaken for the symptoms of normal aging. The brain tissue which needs to be examined for the diagnosis is only available after the death of the patient. There have been no complements or medications to decrease the risk.

In spite of all the advancements no known treatments can reveres or stop the progression of Alzheimer's, but some might be able to improve the symptoms temporarily. The patients suffering from Alzheimer's depend heavily on their family or the care givers for their assistance. The pressure on the family of patients and themselves can be of many kinds such as physical, psychological and most importantly economic. According to the survey done in 2020 nearly 50 million people all around the world suffer from Alzheimer's. People over the age of 65 are usually the prime targets but in recent times even the younger generation i.e. almost 10% of the total generation is ailing from Alzheimer's. Alzheimer's is typically seen in women more than men. According to the statistics Alzheimer's disease is currently ranked as 13th leading cause of death in India.

II. MACHINE LEARNING TECHNIQUES

Deep Learning: Deep learning is a division of machine learning. The mainstay of neural networks is its neural networks. Here the algorithms are same as that of machine learning but they vary due to increase in algorithmic level in deep learning. The notion of deep learning is analogous to that of human brain where all the neurons are interconnected. The main pro of using deep learning technique is they can be instigated on a hefty dataset which can be millions. When it comes to use of images as the dataset, deep learning techniques are widely used.

Convolutional Neural Networks(CNN): CNNs are parallelto customary ANNs. This is due to the datum that they areconsist of neurons that causes self-optimization from learning. An input will be received by each neuron and an operation will be performed by it.

CNNs are widely used in pattern recognition in images. This will allow us to create a model which will help us to create a model using the parameters we ought to consider.

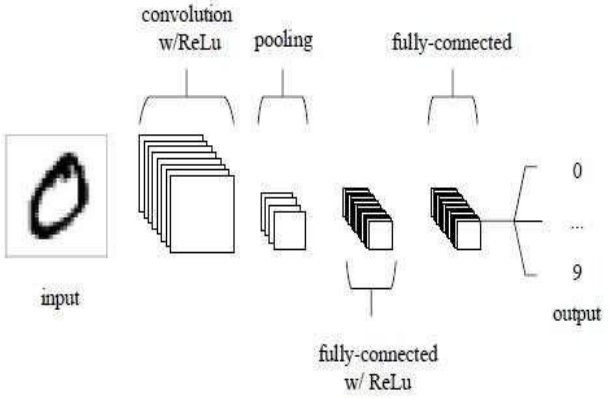

Fig.1. CNN architecture which consists of five layers

ResNet 50 v2: Also entitled as Residual Network. It is called v2 because it is version 2. This contains 50 becauseResNet consists of 50 layers. Proposed by Microsoft research in the year 2015 to solve the problem of vanishing gradient. ResNet uses a system which called as skipping connections. This technique tends to hop the training from some of the layers and tends to connect directly to the output.

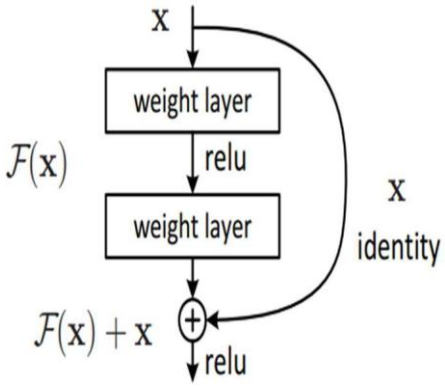

Fig.2. Skip Connection

III. METHODOLOGY

Python: The minute it comes to machine learning python is used. Python does not require an interpreter. Python bargains succinct and comprehensible code. Pythons grammar is clean also the code is decipherable. The straightforwardness of python countenances the developers to code steadfast systems. The developers can devote all their vigor on resolving the glitches of machine learning instead of wasting their time on technical gradations of innumerable languages.

TensorFlow: TensorFlow is an open source and an end to end platform which is used for machine learning. TensorFlow has as logical, supple biota of tools, libraries and communal resources that aids researchers thrust state of the art in machine learning and developers effortlessly construct and set up machine learning powered applications. TensorFlow can directly be installed throughthe command prompt.

Keras: Keras is an API of neural networks which is high level. Keras is adept of running above the TensorFlow. It permits fast trialing through a high level, responsive handler, segmental and extensible API. It can run on both Central Processing Unit and Graphics Processing Unit.

Collection of Data: It is one of the most important course in creating a project. We have downloaded the datasets from Kaggle. Kaggle permits the users to find and circulate data sets, discover and form models in an

environment of web grounded data science.

Feature engineering: It is a machine learning technique that powers data to generate original variables that be situated in the training set. Here we use one hot encoding, it is used to assign one hot encoding of labels to train and val dataset. In this stage we also rescale pixel values of the downloaded dataset images.

Transfer learning: Main steps involved are firstly, using feature extraction from pre trained model and training classification head. Secondly, fine tuning specific layersof pre trained base to suit our classification task.

Training: CNN algorithm is used for training the dataset. The training dataset is the subdivision of the entire dataset which is used to train the model and envisage the results. We train the model for 50 epochs. In this scheme we have used 80% of the data as training data.

Testing: Our model is verified by means of the testing dataset. The testing dataset is engaged to govern how fine the machine can foresee new ripostes supportive of its training. In our project we have used 20% of the dataset asthe testing data.

IV. RESULTS

The main goal of this project is to achieve a model which gives us an accuracy in the highest form. We are getting an accuracy of 97% while testing the dataset.

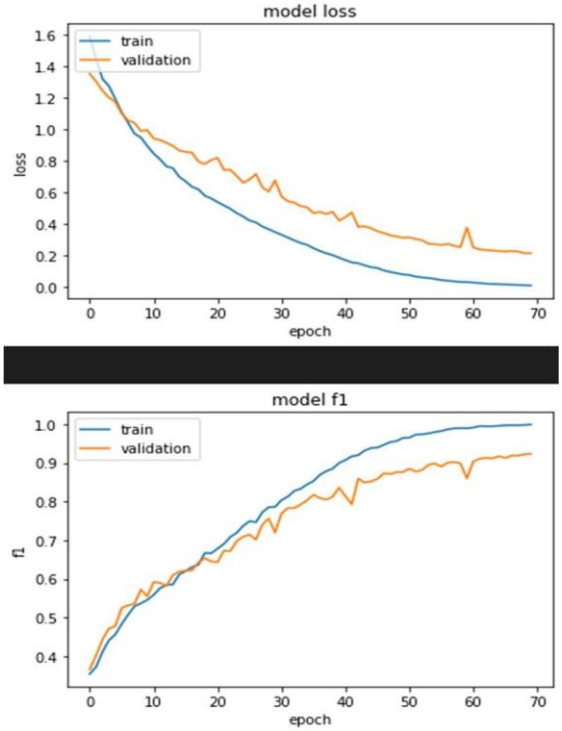

Fig.3. Plot of train_loss and val_loss wrt epochs

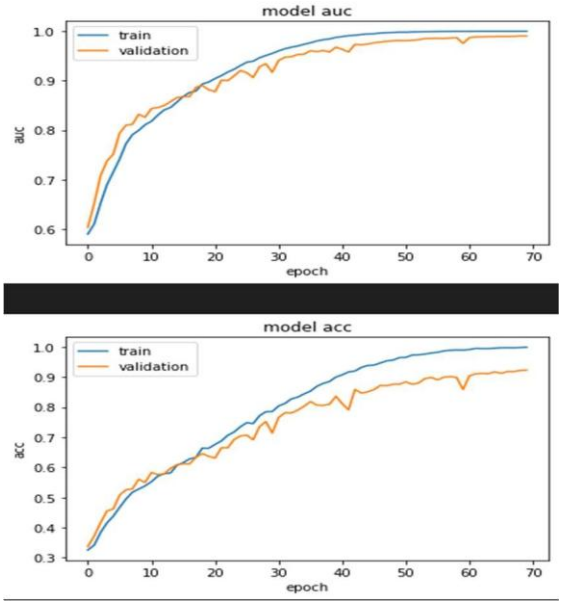

Fig.4. Plot of epochs vs accuracy

After the datasets undergo the required procedures and once we have trained the model and tested the model our final output will be in the form of csv file which will give us the confidence level for each of the three classes. For a single image there will be three confidence levels one for each stage. The highest confidence level of a particular stage showsus that the image belongs to that particular stage.

IV. CONCLUSION

In recent times we have, there has been a lot of places where MRI scans are being used which has its own ill effects. As a result of this we have created a model which considers PET images and predicts the results with highest accuracy.

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