CNN Technique For Detecting Alzheimer's Disease by using MRI Images

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Abstract

Alzheimer’s Disease(AD) is very common neurological diseases these days. Alzheimer’s is one such gradual disorder that destroys memory and other significant mental functions that leads to dementia. It is necessary to detect and treat it in the initial stages itself in order to avoid any major disintegration. Using normal medical methods AD is very difficult to detect, So they used various classifications using MRI images to detect. In order to get better result, Image acquisition and pre-processing has been done. Over these years there are several approaches to detect and treat the brain diseases, now as the technology progressing rapidly this project has come up with an idea to integrate deep learning techniques to detect and understand the severity of brain’s condition of patient.

1 Introduction

Developing in technology now a days computer aided algorithms are very useful in medical diagnosis. Medical image analysis is very useful to extract neural diseases and computer aided algorithms will be able to give more accurate results, in which Alzheimer’s disease is a deadly neural disease which is mostly affected to middle or old age people. This disease causes memory loss that leads to forget their daily routine, language difficulty and other symptoms. The hassle of recalling current activities is the maximum typical early symptom. Sooner or later this disease leads to death.

Stages of AD: Alzheimer's disease is normally categorized into 4 stages: Non-demented, Very mild demented, Mild demented, Moderate demented.

1.1 Non-Demented

A person with Alzheimer’s Disease in this non demented stage are quite similar to other people as it is very minute stage of AD. In this stage they forget some things in their daily life. In this stage the brain size is quite similar (0 % change) to healthy people brain, So it is not able to detect and it is considered as normal stage.

1.2 Very mild Demented

A person with Alzheimer’s disease in this very mild demented stage are defined by general forgetfulness and quite problematic as they start forgetting recently read books, forget their things, confusion with people and places. In this stage the brain size shrinks by 5% compared to healthy people brain, it can be detected using MRI scans and it is considered as early stage.

1.3 Mild Demented

A person with Alzheimer’s disease in this mild demented stage are more disabling and care must be necessary. This stage starts with delusions, restlessness, anxiety and they lose track of time and surroundings. In this stage the brain size shrinks by 10% compared to healthy people brain and it is considered as intermediate stage.

1.4 Moderate Demented

A person with Alzheimer’s disease in this moderate demented stage, symptoms are significant and apparent, so immediate medication is very important. This stage is very hard to overcome as they loss ability to hold a conversation, difficulty in moving and eating. In this stage the brain size shrinks by 20% compared to healthy people brain and it is considered as severe stage.

2 Literature Survey

Diagnostics of AD can be seen through different techniques, of which some are recorded below. With the advanced features of Deep learning and its models, features can be resolved without any human presence. So the experts are concentrated on the development of different models detecting the disease accurately and image classification.

Rajendra Acharya and co-authors [1] (2019). created a Computer Assisted Mind Assessment System that uses T2 weighted brain imaging to detect the presence of Alzheimer's disease. This proposed methodology requires MRI(Magnetic Resonance Imaging) for the extraction process. In this process 66 2D-test images with 256*256 pixels are gathered for evaluation and after that a pre-processing technique is started to enhance the 66 2D-test images that are taken for study. This pre-process runs a median algorithm to supress noise and small defects from the previous 2D images. The features are then revealed from the p value (student test values). Finally, the KNN classifier procedure classifies the image on its features [1].

Xin Bi and co-authors [2] (2019) focused on functional brain division as a means of detecting AD. Regional connectivity positional and adjacency positional are two commonly used deep learning approaches. Convolutional and recurrent teaching strategies are intended to examine in-depth features in the cognitive system without having to manually remove them.. Thereafter a structure of ELM-boosting is designed to increase the accuracy. But the performance is still at risk of variability ROI positions in the active brain network [2].

Amir Ebrahimi and co-authors [3] (2021)used 2D CNNs to draw out brain scans from MRI scans and fill them into a fully connected and full soft layers. Furthermore, 3D CNNs look out for the whole MRI Volume. On the series of 2D and 3D CNNs, the first phase do not concentrate on periodic constraints. There are a lot of readable variables to study in the second phase. Deep learning models are deployed to detect Alzheimer's disease in this article. TCN and different RNNs, such as LSTM, BiLSTM, and GRU, were trained using a stream of data supplied by ResNet-18 which was before trained from MRI images in these

models.. The main problem with this study is that the decrease in brain size is due to both aging and Alzheimer's disease. Therefore, MRI alone is very difficult to distinguish between Alzheimer's disease patients and healthy elderly people[3].

Jia Xian Fong and co-authors[4](2020). The suggested methodology is informed by research on deep learning. and the recovery network without the use of any Magnectic Resonance Imaging pre-processing process. From the foremost writers information, this is the first method to use to find localization and hippocampal differentiation as the first established AD diagnostic method analysis of hippocampal atrophy without the need for any MRI pre-processing process. In this paper, another grade mild cognitive impairment (MCI), intermediate between AD and NC, should added to UTMADNIRAW database for the triple split. Isolating the region of the hippocampus without the use of MRI preprocessing techniques has not been investigated [4].

Ahmad Waleed Salehi and co-authors[5](2020) In this study, used a convolutional neural network classification algorithm for Alzheimer's disease is proposed using MRI images. In this study, 3 classes of images with a total of 1512 lungs, 2633 normal and 2480 Alzheimer's disease are used. Significant accuracy of 99% is achieved. Significant results are obtained when the epoch works with an epoch size of 25 with 99% accuracy among all other results. In this results can be further improved by performing deep convolutional neural networks, which have recently shown potential in neuroimaging studies[5].

Amir Ebrahimi-Ghahnavieh and co-authors[6](2019) Transfer learning with MRI was used to detect Alzheimer's disease. In individual and multiple aspect configurations, multiple Convolution models are developed along the same information. Throughout the first technique, CNN identified the layers in the 2D picture based on problem related procedure within every layer, with a mixture of layer-formed conclusions making the last judgment. The next method involved extracting features from the Convolution layer and fed them to a RNN. For time-order challenges, recurrent neural networks are commonly used. [6].

Karrar A. Kadhim and co-authors [7] (2020). This article first gives an introduction and description of Alzheimer's disease. In Magnetic resonance, the importance of clinical recognition cannot be overstated. The many kinds of Alzheimer's disease and the various treatment options are described. In fact, the purpose of this article is to describe the findings of all current statistical comparison investigations.

It's indeed hard to detect changes inside the brain, finding it challenging to detect medically in the initial phase of Alzheimer's disease, according to the Diagnostic Study of MRI Approaches for Diagnosis of AD, 2017-2020. [7].

Majdah Alshammari and Mohammad Mezher [8] (2021) written this paper in this the primary purpose of this article is to find if or not a person is suffering from AD primarily based on the affected person's mind Magnetic resonance test as well as to similarly become aware of the ad stage within the 4 advert stage training.This paper's procedure is identical to any categorisation total system, which is broken into 3 major stages: training, evaluation, and testing. The machine learning methodology is employed in the training method to provide the prospective version of the convolutional neural network classification

technique via education. The initial studying fee 'Zeta' is allocated to 0.001 for the "Adam" improvement procedure in the python Keras improvement package. After separating the records into 80% during schooling and 20% for analysis, the required epoch number is specified as Ten epochs, and the category efficiency and prototype degradation are computed. [8].

Amir Ebrahimi and co-authors [9](2020) effectively transferred expertise from ImageNet to the ADNI dataset.

ImageNet contains millions of herbal images, while the ADNI dataset contains hundreds of MRI scans of AD patients. We enlarged the shape of two dimensional ResNet-18 to effectively behaviour this switchover. ResNet is a powerful CNN that has already finished nicely at the Training images. Second screens were extended within the 1/3 plane of existence to own three-D filtration in order to convert the original second ResNet-18 toward a 3D version.Every other surface had been altered in in step with the brand new filtration systems. Furthermore, second filters had been duplicated in order to switch the readable parameters from a second ResNet-18 which was before on the ImageNet 3-D ResNet-18.2nd filters had been recreated using the 0.33 measurement. The Taguchi analysis was used to obtain the first-class mixture things for instructing the three-dimensional ResNet-18 on MRI images. The exploratory results demonstrated that the given 3-d ResNet-18 of data augmentation notably progressed AD detection accuracy on the ADNI Magnetic resonance imaging dataset.

The above version could be utilised to another duties that require the use of 3-d. [9]

Rashmi Kumari and co-authors[10](2020) proposed an effective device gaining knowledge of version for detecting the advert in its preliminary levels. The developed version carried out a Gaussian clear out to eliminate undesirable sound, Otsu helps to restore to photo classification, Image enhancement side detection for corner detection, GLCM for image retrieval, FCM for cluster analysis, CNN to the very last category of photos. In comparison to the KNN classifier,

which offered a precision of 59.3 percent and responsiveness of 42.2 percent, the classifier provided a precision of 92.5 and responsiveness of 85.53 percent. Equal outcomes are validated with diverse past works in the study of literature to an effort to illustrate performance of our suggested set of rules. [10].

3 Methodology

The present paper proposes a procedure for detecting Alzheimer’s Disease in its beginning phase using MRI Scans. These MRI scans are collected in open source database called Kaggle (https://www.kaggle.com/code/vishakansubramanian/alzheimer-s-disease-classification-inceptionv3/data)collected 6400 scans of different sizes. These scans are pre-processed to make all scans into fixed size, so that they can be feature extracted and then classified as normal or abnormal using CNN Classifier.

3.1 Image Acquisition

This process is mostly used in collecting datasets from various database, in this paper we used Kaggle dataset and collected 6400 images of various brain MRI scans that are not classified as abnormal or normal. All collected images are of different sizes, so to ensure better results all these are sent to pre-processing technique.

3.2 Pre-Processing

The most commonly approach used for pre processing are of various types like grey Scale image, Noise reduction etc. These steps differ this paper from the base paper. As we used MRI scans for this paper ,the grey scale image process is not done as all the MRI scans are in grey colour. Then we used Adaptive Median Filter to reduce noise from MRI scans to obtain higher accuracy. Then all the MRI scans are Enlarged and compressed to ensure all of them are of same sizes. As mentioned in earlier step all these collected scans are of various sizes, so to process data every single image is fixed to 176x176 either by enlarging or compression.

3.3 Feature Extraction

This paper uses deep learning technique for feature extraction as we need not to extract features manually from the image. All these featured are learned by the network while training the model. Where as in machine learning all these features must be manually given. So in the beginning the original data is sent feature extraction and all the data will be trained according to the required parameters and then it is sent to CNN to classify data. Figure 2 shows the feature extraction technique flowchart.

3.4 Classification

This paper proposes CNN Classifier to get obtain greater results as it is deep learning technique. All these images are classified using Convolutional Neural Network(CNN) as they are trained during feature extraction. Using these trained models the input data entered is convolution and max pooled and then all are fully connected to obtain output with better accuracy. To obtain higher accuracy more epochs must be done. Each epoch will work on increasing accuracy as it does the same process from starting. Then CNN classifies it as abnormal or normal to continue the process. Once if it classified as normal the process stops in the next step. If it is classified as abnormal, again training will be done in the next step. Figure 3 shows the architecture CNN classifier.

3.5 Training

This paper proposes training model to get better results, total 6400 MRI scans are collected for this procedure, so out of them 80% of scans are trained according to the healthy brain and diseased brain parameters and remaining 20% of scans are tested based on the parameters. Once this process is done it begins to detect disease using these trained data. Then based on these results, accuracy is increased as number of epochs increased.

3.6 Graphical User Interface (GUI)

This paper proposed an interface other than producing accuracy, it is used such that an input image is given so the stage of Alzheimer's disease is detected. It detects based on the trained model. This interface was built using various python libraries. Figure 4 shows the Graphical Use interface.

4 Results And Discussion

The present paper has collected MRI images of brain, out of them 80% images are trained according to the required parameters and remaining 20% images are tested. Figure 5 shows the input image of any one stage and Fig. 6 shows the pre-processed image, as all of them are converted to a fixed size and Fig. 7 shows noise filtered image. Then this image is feature extracted and then sent to CNN classifier to early diagnosis of Alzheimer's Disease. The classifier gave an accuracy of 94.92% in Fig. 8 respectively. This improved accuracy represents this paper as improved work compared to base paper. This paper also introduced a Graphical User Interface (GUI), so that when an MRI image is uploaded it directly predicts the stage of AD. Figure 9 shows the predicted stage when it is uploaded in GUI.

5 Conclusion

This paper presents an effective deep learning technique for early detection of Alzheimer's disease (AD). This model used CNN classifier to classify MRI scans as normal or Abnormal. In its initial methodology, Adaptive Median Filter (ADM) is used to reduce noise and then extracted features while training and sent to classification of images. This classifier obtained an accuracy of 94.92%. To prove this as better work compared to other works, this paper propose a Graphical User Interface(GUI) so that stage of the disease is directly detected. The same results are compared to previous works based on the literature survey to prove the efficiency of our proposed algorithm.

Declarations

Funding: As this is normal research there is no funding, we took all data from open source and other information from google.

Interest: IOT, Deep learning are the main interests. Alzheimer's is very deadly disease to very people, to avoid serious problems we came up with this idea.

Availability of Data and Material: The scans data that support the findings of this study are available in resource name Kaggle, hyperlink to dataset (https://www.kaggle.com/code/vishakansubramanian/alzheimer-s-disease-classification-inceptionv3/data).

Code Availability: Custom Code.

Author's Contribution: Dronavalli Jathinsai[1]: Worked on accuracy and GUI.

Narisetti Suhas[2]: Collected all the data from Kaggle,

Pilla Adi Vishnu[3]: Pre-processed and feature extracted data to classify them.

Sasi Kumar P[4]: Guided the whole research.

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Figures

Figure 1

Flowchart of Methodology.

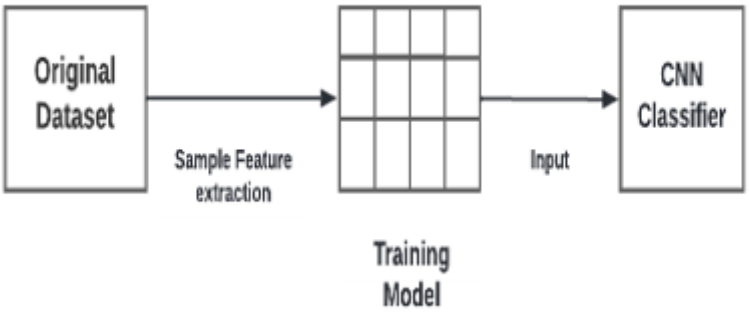

Figure 2

Feature Extraction Technique Flowchart.

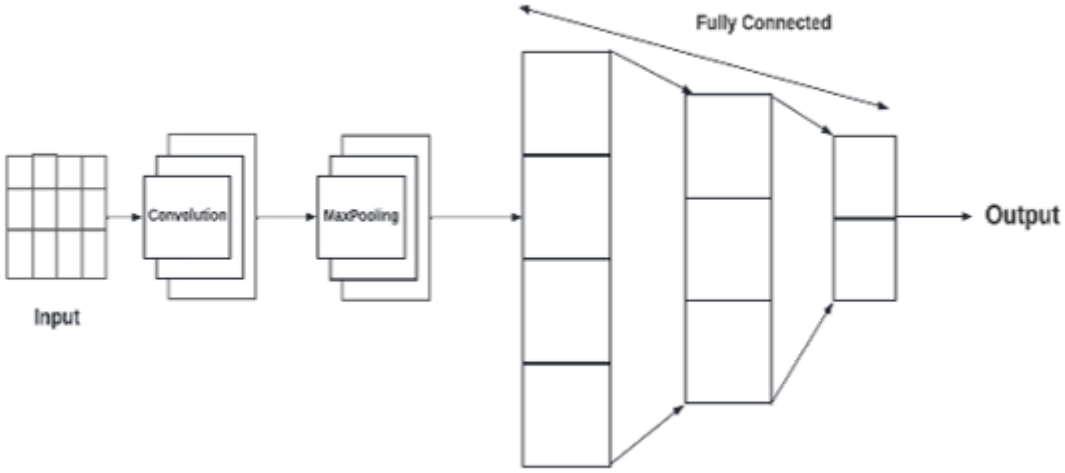

Figure 3

CNN Classifier Architecture.

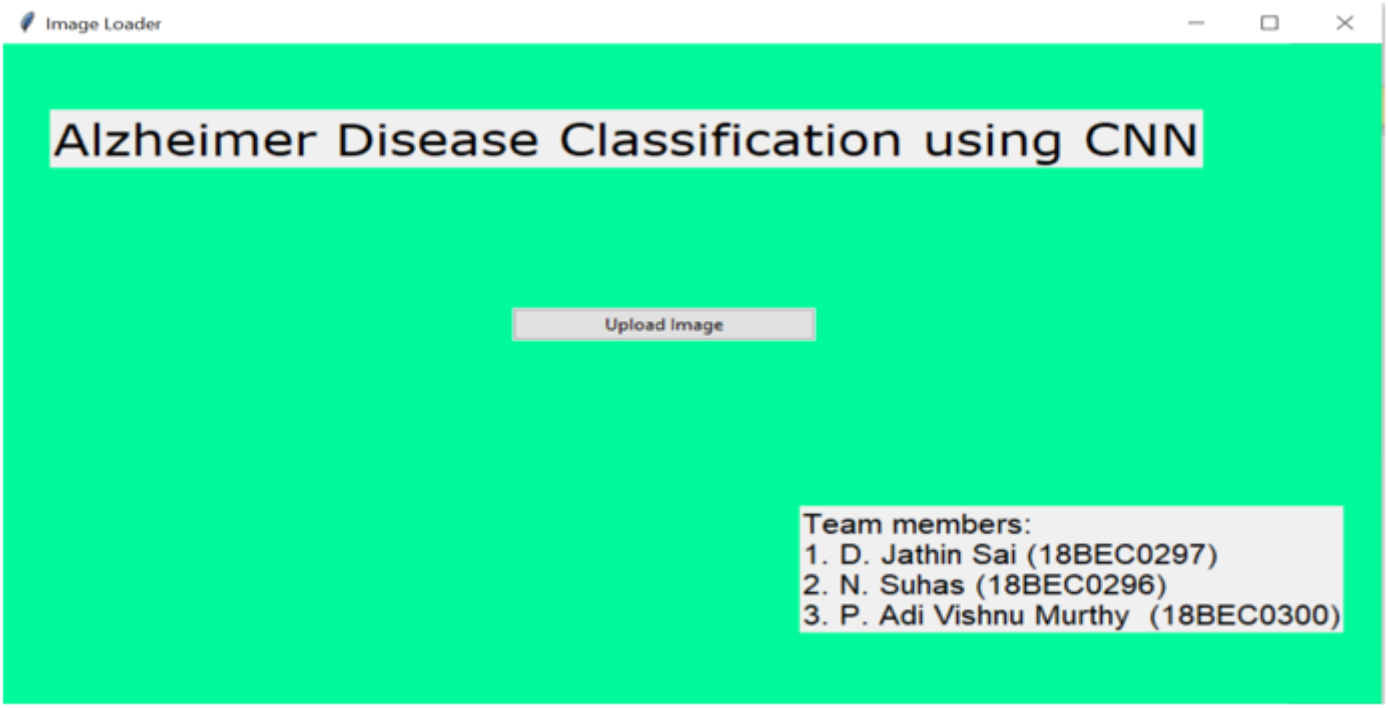

Figure 4

Graphical User Interface.

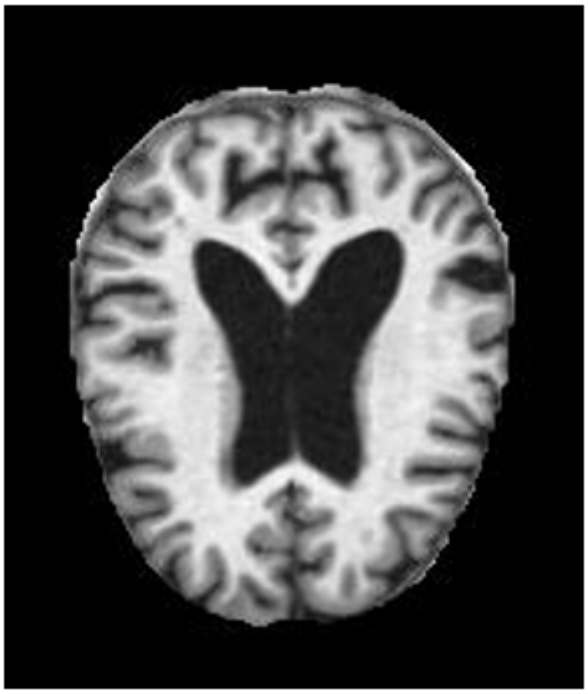

Figure 5

Input Image

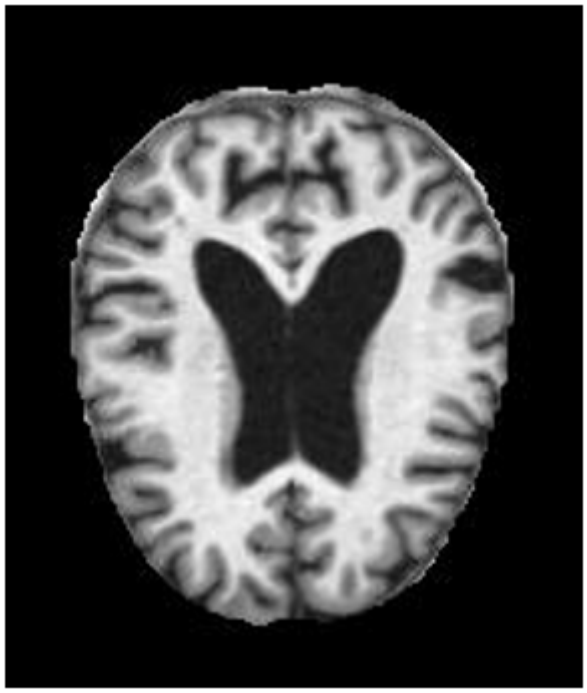

Figure 6

Pre-Processed image

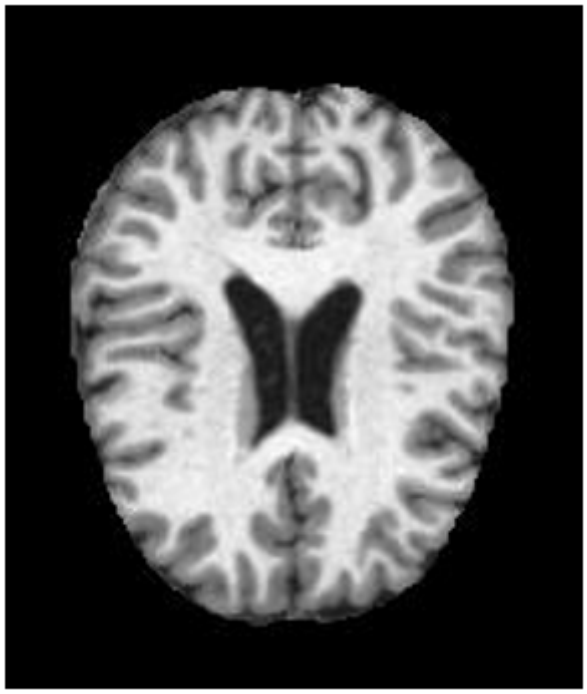

Figure 7

Filtered Image

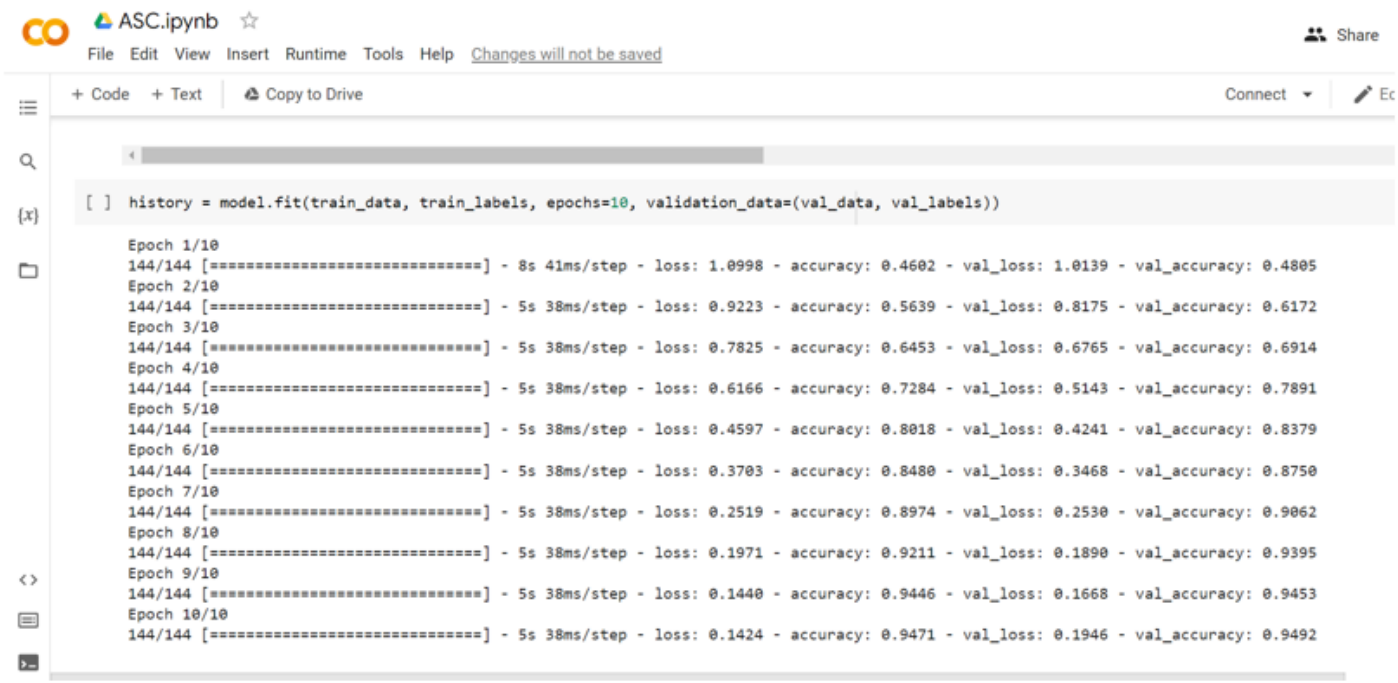

Figure 8

Shows Accuracy of 94.92%

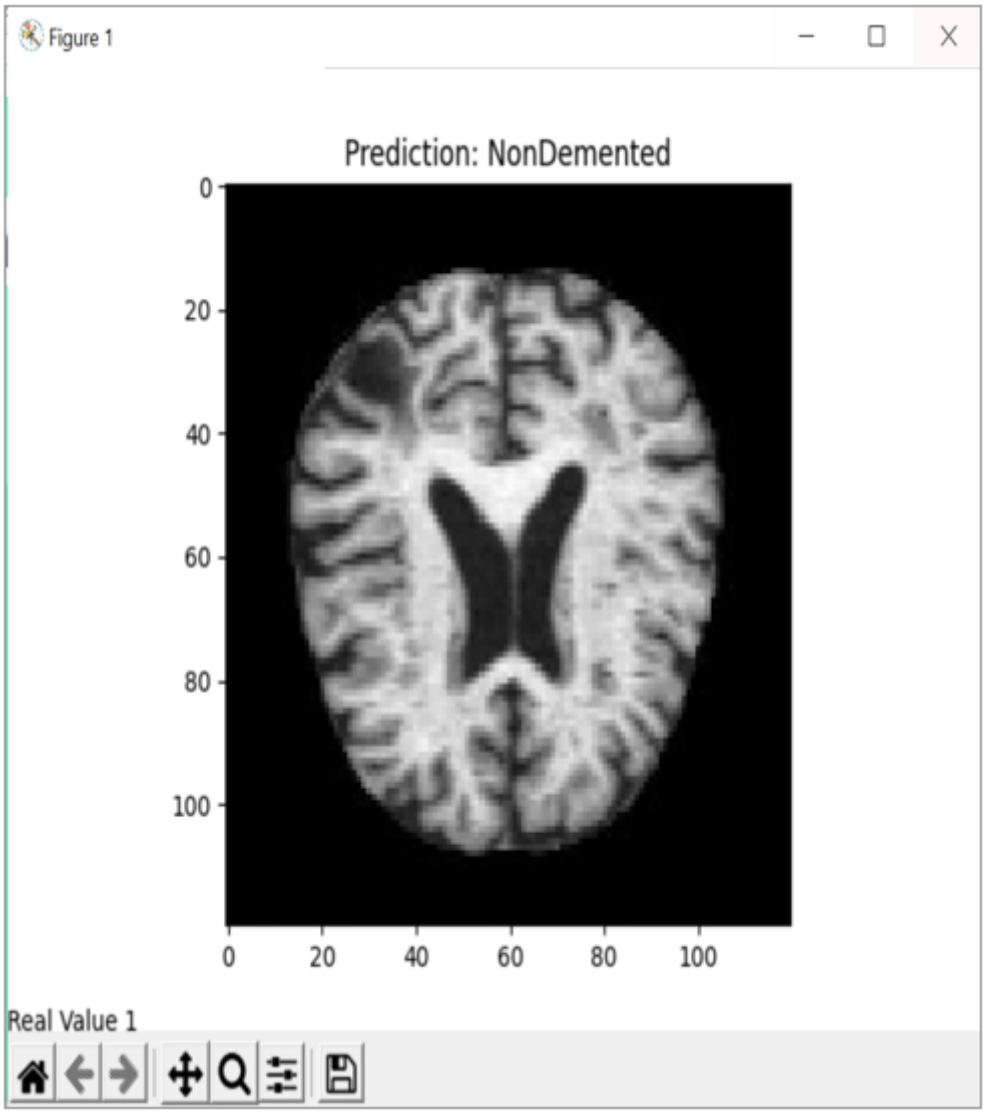

Figure 9

Predicted AD Stage output in GUI