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**1. INTRODUCTION**

Alzheimer’s disease (AD) is an irreversible, progressive neurodegenerative disorder characterized by abnormal accumulation of amyloid plaques and neurofibrillary tangles in the brain, causing problems with memory, thinking, and behaviour. As per NEWS18 survey, an estimated 4 million Indians are living with AD in 2018. By 2050, 1 out of 85 individuals will be affected by AD, this number is projected to rise to nearly 14 million.AD is a disorder of uncertain cause and pathogenesis that primarily affects older adults and is the most common cause of dementia.

The earliest clinical signs of AD is selective memory impairment and while treatments are available to ameliorate or improve the condition of some symptoms, there is no cure currently available.

Brain imaging via magnetic resonance imaging (MRI), is used for evaluation of patients with suspected AD. Clinicians and researchers will have to make use of machine learning techniques that can accurately predict progress of a patient from mild cognitive impairment to dementia.

Here we will be using the MRI longitudinal data that will help us in training the model. In coming months we will look at details and realistic costing, timeline, result analysis. Our primary objective is to detect AD in its early stages so as to prevent repercussions to the brain. Sklearn, scikit, tensorflow and many other modules of python would be used to develop the application.

Further we are planning to develop a web application using HTML, CSS, and JavaScript so that it can be easily used by masses. It would be a beneficial tool for the clinical department as it can be easily used by doctors for early detection of AD.

A supervised learning algorithm analyse the cleaning data and produces an inferred function which can be used for mapping the example. A wide range of supervised learning algorithms are available, each with its strengths and weaknesses.

The most widely used learning algorithms are: [Support Vector Machines](https://en.wikipedia.org/wiki/Support_Vector_Machines), [linear regression](https://en.wikipedia.org/wiki/Linear_regression), [logistic regression](https://en.wikipedia.org/wiki/Logistic_regression), [naive Bayes](https://en.wikipedia.org/wiki/Naive_Bayes_classifier), [linear discriminant analysis](https://en.wikipedia.org/wiki/Linear_discriminant_analysis), [decision trees](https://en.wikipedia.org/wiki/Decision_tree_learning), [k-nearest neighbour algorithm](https://en.wikipedia.org/wiki/K-nearest_neighbor_algorithm), [neural networks](https://en.wikipedia.org/wiki/Artificial_neural_network) ([Multilayer perceptron](https://en.wikipedia.org/wiki/Multilayer_perceptron)), [similarity learning](https://en.wikipedia.org/wiki/Similarity_learning).

**2. LITERATURE SURVEY**

## 2.1 Detection of Microstructural White Matter Degeneration in Alzheimer’s Disease Using Machine Learning Classification of Multicentre DTI Data (2013)

Article - <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0064925>

Summary- For diagnostic classification we used the DTI indices fractional anisotropy (FA) and mean diffusivity (MD) and, for comparison, gray matter and white matter density maps from anatomical MRI. Data were classified using a Support Vector Machine (SVM) and a Naïve Bayes (NB) classifier. We used two cross-validation approaches, (i) test and training samples randomly drawn from the entire data set (pooled cross-validation) and (ii) data from each scanner as test set, and the data from the remaining scanners as training set (scanner-specific cross-validation). In the pooled cross-validation, SVM achieved an accuracy of 80% for FA and 83% for MD. Accuracies for NB were significantly lower, ranging between 68% and 75%

## 2.2 Using 3D MRI scans based on eigenbrains (2015)

Article - <https://www.frontiersin.org/articles/10.3389/fncom.2015.00066/full>

Summary- First, we used maximum inter-class variance (ICV) to select key slices from 3D volumetric data. Second, we generated an eigenbrain set for each subject. Third, the most important eigenbrain (MIE) was obtained by Welch's *t*-test (WTT). Finally, kernel support-vector-machines with different kernels that were trained by particle swarm optimization, were used to make an accurate prediction of AD subjects. Coefficients of MIE with values higher than 0.98 quantile were highlighted to obtain the discriminant regions that distinguish AD from NC.

## 2.3 From Circulating non coding RNA (2019)

Article-<https://www.biorxiv.org/content/10.1101/638213v1.abstract>

Summary - Machine learning models reached an AUC value of 87.6% in differentiating AD patients from controls. Our data provide strong evidence for the relevance of circulating non-coding RNAs to detect Alzheimer’s from a blood sample.

## 2.4 Detection of Alzheimer Disease Based on Histogram and Random Forest (2019)

Article - <https://link.springer.com/chapter/10.1007/978-3-030-17971-7_14>

Summary- we use histogram to transform brain images to feature vectors, containing the relevant “brain” features, which will later serve as the inputs in the classification step. Next, we use the ML algorithms in the classification task to identify AD. The model presented and elaborated in the present contribution demonstrated satisfactory performances. Experimental results suggested that the Random Forest classifier can discriminate the AD subjects from the control subjects. The presented modelling approach, consisting of the histogram as the feature extractor and Random Forest as the classifier, yielded to the sufficiently high overall accuracy rate of 85.77%.

## 2.5 Using deep Siamese neural networks for detection of brain asymmetries associated with Alzheimer's disease and Mild Cognitive Impairment (2019)

Article - <https://www.sciencedirect.com/science/article/abs/pii/S0730725X19300086>

Summary -In this study, a deep learning framework utilizing Siamese neural networks trained on paired lateral inter-hemispheric regions is used to harness the discriminative power of whole-brain volumetric asymmetry

**3. MOTIVATION**

It is estimated that 4 million Indians are currently suffering from Alzheimer’s disease as per the year 2018. By 2050, 1 out of 85 individuals will be affected by AD, this number is projected to rise to nearly 14 million.

In machine learning, a good understanding of a problem and limitations of the algorithms are needed to be understood well to get effective results. Therefore, it has a good chance for success if an experimentation is properly conducted and training is carefully and correctly employed and results are vigorously validated.

Therefore, we can use Machine Learning to equip machines with diagnostic capabilities that will be effective in dealing with AD since it is neither curable nor reversible.

**4. OBJECTIVE**

The project named “Early Detection of Alzheimer’s disease using Machine Learning” has been designed with the following objectives:

4.1 Early detection of AD allows the patients to take preventive measures before irreversible brain damages are shaped.

4.2 To reduce the prospected increase in no. of affected patients.

4.3 Since the disease is not curable, if it is detected at an earlier stage it allows the individual and his or her family members to be better prepared for the coming situation.

4.4 Since many condition can produce symptoms resembling those of early Alzheimer’s’ correct diagnosis is essential to avoid any repercussions.

**5. PROPOSED APPROACH AND METHOD**

* 1. Data Collection

### We will be using dataset from Open Access Series of Imaging Studies (OASIS). The dataset is named as Longitudinal MRI Data in non-demented and demented older adults.

* 1. Data Preparation

We will be training our model based on following features present in our data such as-[Mini Mental State Examination](http://www.dementiatoday.com/wp-content/uploads/2012/06/MiniMentalStateExamination.pdf) (MMSE), [Clinical Dementia Rating](http://knightadrc.wustl.edu/cdr/PDFs/CDR_Table.pdf)(CDR), [Estimated Total Intracranial Volume](https://link.springer.com/article/10.1007/s12021-015-9266-5) (eTIV), [Normalize Whole Brain Volume](https://www.ncbi.nlm.nih.gov/pubmed/11547042) (nWBV), [Atlas Scaling Factor](http://www.sciencedirect.com/science/article/pii/S1053811904003271) (ASF).

5.3 Choosing an appropriate model

We will be employing some machine learning models such as Support Vector Machines, Decision Tree and Random Forest.

5.4 Training and Evaluating the Model

We will be using the above proposed machine learning models and train them on our data based on certain features. MMSE is one of the gold standards for determining dementia and hence we think it is an important feature to include.

5.5 Parameter Tuning

We will be variating features present in our dataset for training our models and analyse which model predicts our results more accurately.

5.6 Making predictions

Based on the results of the above used models, we will be able to predict if a person will suffer from Alzheimer’s in the future. Furthermore we can tune our model and employ many more datasets to work on so that our prediction has higher accuracy.

**6. CONCLUSION**

The team's primary intention was to explore how machine learning can make a difference in the clinical environment.

The main takeaway for us is that there are several key factors which are caused by Dementia and we should continue to check it and clear the process in different ways. For the further study, it is necessary for us to improve our understanding through more sophisticated EDA process with a larger sample size.

**7. REFERENCES**

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