# A SURVEY ON ALZHEIMER'S DISEASE PREDICTION USING MACHINE LEARNING METHODS

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**Abstract**: Alzheimer's Disease is a severe neurological brain disease. It injures brain cells, leading patients to lose their memory, mental functioning and ability to perform everyday duties. Alzheimer's Disease is terminal, although early identification can significantly reduce symptoms. Machine learning algorithms can greatly increase the accuracy of Alzheimer's disease diagnosis, and these techniques have recently seen a lot of success in medical picture research. However, there has been relatively limited research into using machine learning algorithms to identify and classify Alzheimer's Disease. In this analysis, we defined the detailed research which has already been done on the detection/classification of Alzheimer's Disease. We also highlighted the methodology and results of five studies which have significantly produced improved results compared to traditional methods.

**Keywords**—Machine Learning, Alzheimer's Disease, MRI, attention network, VGG, transfer learning.

## I. INTRODUCTION

Alzheimer's disease is a cause of dementia. Dementia is caused by several brain disorders that cause loss of memory and thinking ability. Alzheimer's is one of the brain diseases that cause dementia. This disorder causes mini-strokes in the brain, which lead to slow brain cell destruction and neurological disease. A person with this disorder will not be aware of the paralysis due to small attacks, and it happens without any certainty. This happens in cases of loss of men or women.

The disorder mainly affects people over the age of 65. Until recently, it has not always been possible to calculate this age. There are. Early sufferers are usually aware of their adjustment. New distractions and memory loss affect them profoundly; they keep neglecting things and may not be able to manage their affairs usually. Even when talking with family members, loved ones, friends, etc., they feel that there are some topics to discuss and practice expression. This causes them to talk less, and this advanced degree causes them to forget about their immediate family members. They become depressed when they declare that they no longer function as they used to.

Machine learning is used to interpret and analyze data. Furthermore it can classify patterns and model data. It permits decisions to be made that could not be made generally utilizing routine systems while sparing time and endeavors. Machine learning methodologies have been extensively used for computer-aided diagnosis in medical image formation mining and retrieval with wide variety of other applications especially in detection and classifications of brain disease using CRT images and x-rays. It has just been generally late that AD specialists have endeavored to apply machine learning towards AD prediction. As a consequence, the literature in the field of Alzheimer's disease prediction and machine learning is relatively small. However, today'simaging technologies and high throughput diagnostics have lead us overwhelmed with large number (even hundreds) of cellular, clinical and molecular parameters.

In terms of brain structure, Figure 1 shows the distinctions between a normal brain and one affected by Alzheimer's disease. Alzheimer's disease mostly affects the cerebral cortex, ventricles, and hippocampus. The cerebral cortex, the area of the brain that processes language and information, decreases in Alzheimer's patients, causing them to progressively lose their capacity for learning and memory. The ventricular system, on the other hand, is a network of interconnected brain cavities that generates, channels, and drains the cerebrospinal fluid that cushions and protects the brainand spinal cord. Alzheimer's patients have enlarged ventricles, which are filled with cerebrospinal fluid, anda substantially diminished hippocampus, a brain region essential for the creation of new memories.

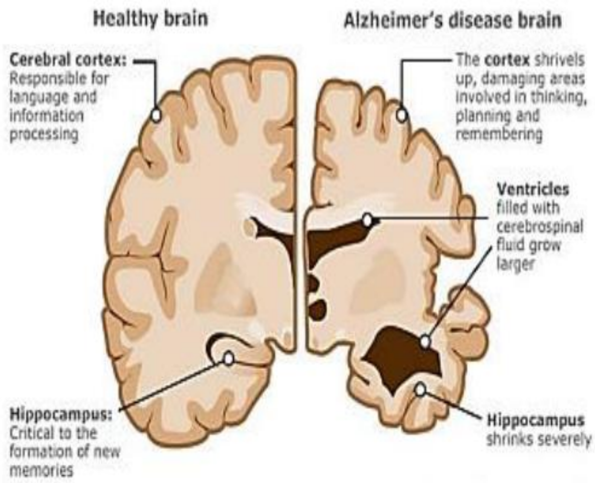


Fig.1 Anatomy of Healthy and Alzheimer's Brain

## II. PROBLEM STATEMENT

There is no proper awareness about Alzheimer Disease. As they age, they may experience changes in your physicalabilities and walking, sitting, and eventually swallowing. Individuals may need substantial assistance with daily activities as their memory, and cognitive skills continue to decline. At this stage, individuals may need 24/7 assistance for personal care and daily activities. When people suffer from dementia, their ability to communicate, adapt to their environment, and eventually move is lost. It becomes much more difficult for them to communicate pain through words or phrases.

## III. LITERATURE SURVEY

According to research [1] The most prevalent and common type of dementia is Alzheimer's disease (AD). AD can be clinically diagnosed by physical and neurological examination, so there is a need for developing better diagnostic tools for AD. MRI (Magnetic resonance imaging) scans were processed by Free Surfer, a powerful tool suitable for processing and normalizing brain MRI images. The multistage classifier used in this thesis produced a good performance for AD detection as compared with previous individual machine learning approaches, such as SVM and KNN.

Based on [2] In this paper, we have proposed a new classification framework based on combination of CNN and RNN to perform the longitudinal analysis of structural MR images for AD diagnosis. CNN model was proposed to extract the spatial features of each time point and generates singletime classification result, while RNN based on cascaded

BGRU was used to model the temporal variations an extract the longitudinal features for improving disease classification. Experimental results on the ADNI dataset demonstrate the effectiveness of the proposed classification algorithm. In the future works, we will include other imaging features such as structural and functional connection networks of brain for RNN based longitudinal analysis. In addition, our work can be Experimental results show that the proposed method achieves classification accuracy of 91.33% for AD vs. NC and 71.71% for pMCI vs. sMCI, demonstrating the promising performance for longitudinal MR image analysis.

The [3] Alzheimer's disease seriously affects the lives of the elderly and their families. Mild cognitive impairment (MCI) is a transitional state between normal aging and Alzheimer's disease. MCI is often misdiagnosed as the symptoms of normal aging, which results to miss the best opportunity of treatment.

In this paper, the neuroimaging diagnosis and the clinical psychological diagnosis are combined. The experimental results show that the proposed multi-modal auxiliary diagnosis can achieve an excellent diagnostic efficiency. The consistency of the output of two convolutional neural networks is judged by correlation analysis. If the results of the two CNN models are similar, it is intuitive that the diagnosis for the same patient are consistent with the difference modality diagnosis. The accuracy rates achieve 95.9% (CN vs. AD), 85.0%(CN vs. MCI), and 75.8% (MCI vs. AD), respectively.

As in [7] The accurate diagnosis of Alzheimer's disease (AD) is essential for timely treatment and possible delay of AD. Fusion of multimodal neuroimaging data, such as MRI and PET, has shown its effectiveness for AD diagnosis. The proposed MM-SDPN algorithm is applied to the ADNI dataset to conduct both binary classification and multiclass classification tasks. Deep learning and deep polynomial networks. It can be found that MM-SDPN algorithm achieves the best performance with mean classification accuracy of 97.13%.

In [10] 15 metabolites associated with cognition including sub fractions of high-density lipoprotein, docosahexaenoic acid, ornithine, glutamine, and glycoprotein acetyls. Six of the metabolites were related to the risk of dementia and lifestyle factors independent of classical risk factors such as diet and exercise. Measurements of cognitive function and blood drawn for metabolite measurements were concurrent in all metabolite measurements from our discovery and 73.6% of the samples in the replication.

As with reference [8] "View aligned hypergraph learning for Alzheimer's disease diagnosis with incomplete multimodality data", Med. Image Anal., 2017. View-aligned hypergraph learning (VAHL) method to explicitly model the coherence among views. We evaluate our method on the baseline ADNI-1 database with 807 subjects and three modalities. Experimental results show that our methodoutperforms state-of-the-art methods for AD/MCI diagnosis. We develop a view-aligned hypergraph classification model to explicitly capture the underlying coherence among views, as well as automatically learn the optimal weights of different views from data. Results on the baseline ADNI-1 database with MRI, PET, and CSF modalities demonstrate the efficacy of our method in AD/MCI diagnosis. this paper, they propose a view-aligned hypergraph

ISSN: 2366-1313

learning (VAHL). By using VAHL accuracy of 78.9%.

According to [10] In this paper, the authors developed a system to improve the prediction of progression to Alzheimer's Disease (AD) among older individuals with mild cognitive impairment. The dataset used was the ADNI dataset for predicting the progression of AD. PHS, Atrophy score and MMSE predictor algorithm were used for the prediction of the progression, highest accuracy of 78.9% along with a sensitivity of 79.9% was found when all three predictor algorithms were used together.

## IV. MACHINE LEARNING TECHNIQUES FOR ALZHEIMER DETECTION

These techniques are extensively used in the clinical application and also established noteworthy attention in the past eras. It is well-thought-out as a division of AI as it allows the removal of an expressive model or pattern from samples. These approaches are mainly categorized into clustering/unsupervised and classification/ supervised. Below is a brief explanation of Classification i.e. Supervised Learning and clustering i.e. Unsupervised Learning. The main idea behind this machine learning approach is centered on a trainer which trains label data with the label group by utilizing a training set. Different types of biomarkers are called features that must be learned for the difficulty at hand. Fig. 2 shows the fundamental framework for the ML approach for the classification of AD.

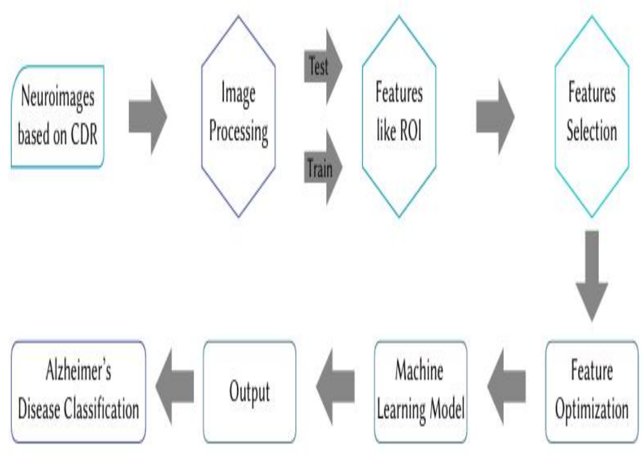


Fig.2 The fundamental framework for the ML approach for the classification of AD.

### a) Bayesian Classifiers

Bayesian classifiers are the simple statistical classifier cantered on Bayes theorem with robust (naïve) independence expectations amongst the feature. Instead of undergoing training by a single algorithmic approach, Naïve Bayes learns by utilizing algorithms centered on universal rules.Seixas et al. give a Bayesian classifier i.e. Bayesian network decision model for helping detection of Alzheimer disease, Mild Cognitive Impairment (MCI), and Normal Control (NC), while they achieved higher results as compared to numerous famous classifiers like simple Naïve Bayes, Logistic Regression Classification (LRC), multilayer perception Artificial Neural Network, decision table, choice base enhanced through Adaboost approach and J48 Decision Tree.

**b) Support Vector Machine (SVM)**

Support Vector Machine is a very common machine learning algorithm used for both regression and classification-based problems.For non-linear separable data, sample points are mapped over a high dimensional plane exploiting the boundary among points in a high dimensional space. This transformation of data-points from one dimension to another dimensional space is known as the kernel trick. This optimal algorithm is established over the 'Training Set' where the training data is utilized for maturing the procedure that can distinguish among previously defined clusters and a 'Testing Set' where the procedure is utilized to forecast the clusters where the new observations go. To plot the training set from input space to a high-level feature space, Kernel functions can be utilized. The data points that are positioned nearest to the decision surface are support vectors. Support vector machine have different variants, for example hierarchal SVM, radial basis function-based SVM and AdaBoostSVM.

**c) Logistic Regression**

Logistic Regression Classification classifies the input samples to their respective classes based on the probabilistic value returned through the logistic sigmoid function. To differentiate Alzheimer's Disease from other sorts of dementia, Logistic Regression Classification is utilized in various Alzheimer's Disease analyses. LogisticRegression performs classification for Alzheimer's disease MRI in a similar way to SVM. To design a prediction model for the timely detection and progression of Alzheimer's Diseases, Johnson et al. utilized Logistic Regression Classification (LRC). In the large feature space for finding the optimum features like neuropsychological tests, a genetic algorithm (GA) is utilized. These Optimal features from the Genetic Algorithm are maintained as the inputs of the Logistic Regression Classification (LRC). It appears that the Genetic Algorithm can enhance the detection of Alzheimer's disease. For the detection of different analyses of dementia, a two-level prediction model was submitted by Mazzocco and Hussain.

**d) Linear Discriminant Analysis**

ISSN: 2366-1313

Linear Discriminating Analysis (LDA) is thoroughly connected to studies of variance and regression studies which show one dependent variable as a linear combination of other features or dimensions. Linear Discriminating Analysis (LDA) is also called 'Fisher Linear Discriminant 'which is the most common size reduction approach. Linear Discriminating Analysis (LDA) develops a linear discriminant function resultant in minimum errors.

Zhao et al. suggested an enhanced iterative trace ration (iITR) procedure to resolve the trace ratio linear discriminate analysis (TR-LDA) problematic for dementia analysis and attained improved results as compared to the principal component analysis (PCA), locality preserving projections (LLP), and maximum margin criterion (MMC). horn et al. utilized the image features reduced by the partial least square (PLS) to LDA for distinguishing AD from FTD and attained an accuracy of 84%, a sensitivity of 83%, and a specificity of 86% on perfusion SPECT images.

**e) K-means Clustering (Hard Clustering)**

The Clustering (grouping) approach is also known as unsupervised learning, as the classification approaches categorized instances in dissimilar groups, but in the clustering approach (unsupervised learning) there is no training dataset to practice. Inmedical imaging issues and the detection of Alzheimer's disease, this clustering approach is widely utilized e.g. segmentation of brain tissue, hippocampal division, and entire cerebrum division i.e. segmentation. Vargheseet al. provided efficiency for various clustering procedures aimed at describing the physiognomies of cerebrum muscles for assessment of Alzheimer's disease in various phases. K-means is an unsupervised learning approach that is mainly utilized when having data without label, which means data having no definite clusters and categories. It is a famous method utilized to assemble in pre characterized digits of K groups i.e. K-means grouping which is a hard-grouping approach. This procedure aims to find out clusters in the data set.

**V.CONCLUSION**

This paper includes a variety of methodologies for detecting and classifying Alzheimer's disease. It also highlights recent research in this field that has been published in the literature during the last several years. Finally, we examined various studies that focused on Alzheimer's disease

ISSN: 2366-1313

detection/classifications using machine learning models and outperformed state-of-the-art found that they methods by a substantial margin. This will assist researchers in leveraging existing functionalities of various tools, interpreting vast amounts of data, and focusing on potential improvements by selecting features appropriate for the investigation.

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