A Survey on Classification of Alzheimer Disease

Moorthy A[1], Lavanya N[2], Madhumitha P M[3]
[1]Assistant Professor, Dept of Computer Science and Engineering
[2, 3]Dept of Computer Science and Engineering
[1, 2, 3]Easwari Engineering College, Ramapuram, Chennai, India

Abstract- *The Alzheimer's disease has been connected to a deficiency in the brain neurotransmitter acetylcholine.Alzheimer's disease is a brain disorder that slowly destroys memory and thinking skills and, eventually, the ability to carry out the simplest conversation. Alzheimer treatment options depend on the alzheimer or not. The classification of alzheimer is carry out by biopsy, which is not usually conducted before definitive brain surgery. The improvement of technology and deep learning can help neurologists in alzheimer diagnostics without invasive measures. MRI scan dataset are taken from kaggle, which comprises of two classes of Alzheimer for training and testing of the model.A deep-learning algorithm that has achieved substantial results in image classification is the convolutional neural network (CNN). It is predicted that the success of the obtained results will increase if the CNN method is supported by adding extra feature extraction methods and classify successfully alzheimer normal and abnormal image.*

Keywords- Alzheimer, deep learning, TensorFlow, Convolutional neural network (CNN), Magnetic Resonance imaging (MRI), Demented.

I. INTRODUCTION

Alzheimer's disease (AD), a chronic neurodegenerative disease causing the death of nerve cells and tissue loss all over the brain, usually starts slowly and worsens over time. The cost of caringfor AD patients is also expected to increase dramatically, thus the need of individual computer-aided systems for early and accurate AD diagnosis.CNN's are widely used to recognize satellite images, process medical images, forecast time series, and detect anomalies.The architecture of a convolutional network generally consists of four types of layers: convolution, pooling, activation, and fully connected.The classification of alzheimer is performed in a comparable way. The improvement of technology and deep learning can help neurologists in alzheimer diagnostics without invasive measures. A deep-learning algorithm that has achieved substantial results in image classification is the convolutional neural network (CNN). The classification was performed using a T1-weighted contrast-enhanced MRI image database which contains Alzheimer or not. As input, we used whole images, so it was not necessary to perform any preprocessing of the alzheimer. Samples of number of images are collected that comprised of different classes such as normal and abnormal. Different number of images is collected for each class that was categorized into input images. We proposed a Deep Learning (DL) based alzheimer prediction method to predict the result. The DL technique used in the study is the Convolutional Neural Network (CNN). It is predicted that the success of the obtained results will increase if the CNN methodis supported by adding extra feature extraction methods and classify successfully alzheimer.

II. LITERATURE SURVEY

[1] This article is about to find the technology similarities between patents applied in various medical fields. Subject action object(SAO) and unified modelling language(UML) methods are used to weigh the technology similarity. Finally, the proposed method is illustrated with patents related to Alzheimer's disease to evaluate its possibility.The sum and average of the absolute values are taken which results in the precise scale than IPC and keywords which is the traditional method. It has several limitations like reduction in chemical equations and formulas in a patent may lead to less precision and semantic relationships needed to be improved.

[2] Alzheimer disease is detected using support vector machines which is one of the machine learning techniques by identifying from 5 novel non-amyloid blood plasma proteins. A combination of A2M, ApoE, BNP, Eot3, RAGE and SGOT were identified as key protein profiles for early detection of alzheimer.Disease detection models based on the identified panels achieved sensitivity greater than 80%, specificity greater than 70%, and area under receiver operating curve (AUC) of at least 0.80 at prodromal stage of AD. As the result it can detect the disease at the earliest than the usual biomarkers can detect leading to early identification of the Alzheimer disease.

[3] This paper presents a novel deep learning model for multi-Class Alzheimer's Disease detection and categorizing using Brain MRI Data. Open Access Series of Imaging Studies (OASIS) database is taken with four classifications such as non demented, very mild demented,mild dementedand moderate demented stages. A basic CNN architecture which is

imagenet is constructed and various filters are used to bring out accuracy of 85.3%. Although it can produce good accuracy, it has some shortcomings such as working with other databases for better performance.

[4] In this paper work, the Alzheimer disease is classified as healthy control (NC) and AD is done by deep learning techniques. Two major CNN architecture such as VGG 16 net and Mobilenet are compared and the resultant is used to determine the Alzheimer disease. The experiment only used these limited numbers of images to train the network. By comparing the accuracy and loss graph of VGG 16 net and Mobile net, it is concluded that Mobile net has higher accuracy than VGG 16 net as complexity is low.

[5] In this model, they have used a framework ofthe combination of multiple kernels to combine edge features and node features for AD classification. Astandard pre-processing procedure is used to the 710 T1-weighted MRI brain images. A simple weight detector(F-score) is used to combine six classifiers.The results indicate that 3D texture could detect the subtle texture differences between tissues in AD impairment and texture features of MRI images which is way more superior to their previous model that uses only edge detection not node detection.

Authors in [6] proposed a deep multi-task multi-channel learning (DM2L) framework for simultaneous Alzheimer's disease classification using MR imaging data and clinical score regression using demographic information (i.e., age, gender, and education) of subjects. Firstly, discriminative anatomical landmarks were identified from MR images in a data-driven manner, and then extract multiple image patches around these detected landmark Experimental results shows that this approach outperforms several state-of-the-art address in both the tasks of disease classification and clinical score regression. The limitations faced was that the process of landmark detection is independent of the proposed deep feature learning framework and performance degradation.

Authors in [7] proposed deep neural network (DNN) with fully connected layers to perform binary classification. Here the experiment was performed with two groups: Alzheimer Disease (AD) and cognitively Normal (CN).Asthe proposed model was a binary classifier, they have used binary cross-entropy as a loss function,three different typesof activation functions for the hidden layers used in DNN and by using a 5-fold cross validation average accuracy score was calculated. Finally in this model,they tested DNN with a combination of Leaky ReLU, PreLU, and ELUin hidden layers.The proposed DNN with the best validation accuracy score achieve 85.19%, 76.93%, and 72.73% accuracy on the test data for AD vs. CN, Mild Cognitive Impairment (MCI) vs. CN, and AD vs. MCI classifications.

[8] In this model,they have used a Fourier descriptor method which was capable of describing shape frequency information to examine the effectiveness of classification in AD patients and healthy subjects (HS) using brain shape information. In this experiment they have analyzed the shape of lateral ventricle because of its relatively simple shape by P-type Fourier descriptor, to express the shape of ventricle in coronal plane images. Here Classification was performed by support vector machine by taking the several combinations of descriptors as feature. The results revealed classification accuracy of 87.5%.

In [9] a deep learning algorithm that predicts the final identification of Alzheimer disease (AD). Prospective 18F-fluorodeoxyglucose(FDG) PET brain images from the Alzheimer's Disease Neuroimaging Initiative (ADNI). Convolutional neural network of InceptionV3 architecture was trained on 90% of ADNI data set and tested on the remaining 10%, as well as the independent test set, with execution compared to radiologic readers. This model achieved 82% specificity at 100% sensitivity, an average of75.8 months prior to the final diagnosis.

[10] In this paper, extreme learning machine (ELM)-based grading method is used to efficiently combine multimodal data and predict MCI-to-AD conversion. Feature extraction and feature selection is done for MRI images. Then multiple modalities of MCI subjects were individually graded using the ELM method. Finally, these grading scores calculated from different modalities were fed into a classifier to differentiate subjects with progressive MCI from those with stable MCI. . The proposed method was tested on the Alzheimer's Disease Neuroimaging Initiative (ADNI) cohort, and an AD prediction accuracy of 84.7 percent was attained. Experiments on predicting AD conversion from MCI within different periods showed related results with the 3-year prediction.

COMPARISON TABLE

Author	Year	Approach	Result
Rongrong Li, Xuefeng Wang, Yuqin Liu, Shuo Zhang	2021	Subject action object (SAO) and unified modelling language (UML)	This article shows the weight of technology similarity of patents by SAO method is more than traditional methods
Eke, Chima S., Emmanuel Jammeh, Xinzhong Li, Camille Carroll, Stephen Pearson, and Emmanuel Ifeachor	2020	Support vector machines	support vector machines method is used to identify from 5 novel non-amyloid blood plasma proteins
Jyoti Islam,Yanqing Zhang	2017	CNN architecture (Image net) and OASIS database	A basic CNN architecture which is image net is constructed and various filters are used to bring out accuracy of 85.3%
Xiaoling Lu, Haifeng Wu, Yu Zeng	2019	VGG 16 net andMobile net	VGG 16 net and Mobile net are compared and the resultant is used to classify Alzheimer disease orhealthy control
J. Liu, J. Wang, B. Hu, F. -X. Wu and Y. Pan	2017	3D Texture, Individual Hierarchical Network, Multiple Kernel Learning	The results also indicate that 3D texture could detect the subtle texture differences between tissues in AD which is way more superior to their previous model
M. Liu, J. Zhang, E. Adeli and D. Shen	2019	a deep multi-task multichannel learning and clinical score regression	Experimental results shows that this approach outperforms several state-of-the-art approaches in both disease classification and clinical score regression
Rukesh Prajapati, Uttam Khatr, Goo Rak Kwon	2021	deep neural network, Leaky ReLU, ELU, PReLU	The proposed model achieved 85.19% for AD vs. CN classification.
H. Fuse, K. Oishi, N. Maikusa, T. Fukami and J. A. D. N. Initiative	2018	Shape information, P-type Fourier descriptor	The proposed approach achieved an accuracy rate of 87.1%
Yiming Ding, Jae Ho Sohn, MD, Michael G. Kawczynski, MS, Hari Trivedi, MD	2018	Convolutional neural network of InceptionV3 architecture	This model achieved 82% specificity at 100% sensitivity, an average of75.8 months prior to the final diagnosis.
Lin Weiming, Gao Qinquan, Yuan Jiangnan, Chen Zhiying, Feng Chenwei, Chen Weisheng, Du Min, Tong Tong	2020	extreme learning machine (ELM)-based grading method	The proposed approach brings an accuracy of 84.7%for an AD prediction using ELM based grading method.

III. CONCLUSION

The proposed system aims to create an accurate and efficient way to classify Alzheimer disease. A deep-learning algorithm which achieves substantial results in image classification is the convolutional neural network (CNN).MRI brain image dataset is taken which is segmented as demented and non-demented classification. The dataset is trained and tested with two architectures – Manual CNN and Alexnet architecture. The overview of methodologies for detecting the abnormalities in alzheimer images which includes collection of alzheimer image data set, preprocessing techniques, feature extraction techniques and classification schemes was discussed. It is observed that manual CNN serves better than Alexnet as it has gradual change in loss value and provides better output. The trained model is saved and deployed using Django framework in which the output is predicted successfully with 92% accuracy. Furthermore, it can be improved using real time dataset provided from medical department to train and test the model for classifying Alzheimer disease.

REFERENCES

[1] Rongrong Li, Xuefeng Wang, Yuqin Liu, Shuo Zhang, 'Improved Technology Similarity Measurement in the Medical Field based on Subject-Action-Object Semantic Structure: A Case Study of Alzheimer's Disease', IEEE Transactions On Engineering Management, IEEE, vol no 10, issue no 2, pp: 1 – 14,2021.

[2] Eke, Chima S., Emmanuel Jammeh, Xinzhong Li, Camille Carroll, Stephen Pearson, and Emmanuel Ifeachor. "Early Detection of Alzheimer's Disease with Blood Plasma Proteins Using Support Vector Machines." IEEE Journal of Biomedical and Health Informatics 25, no. 1 (2020): 218-226.

[3] Jyoti Islam,Yanqing Zhang, 'A Novel Deep Learning based Multi-Class Classification Method For Alzheimer's Disease Detection using Brain MRI Data ' , In the proceedings of Researchgate, Georgia,USA,2017.

[4] Xiaoling Lu, Haifeng Wu,Yu Zeng,2019, 'Classification of Alzheimer's disease in MobileNet', Journal of Physics: Conference Series,china, pp: 1345-1377.

[5] J. Liu, J. Wang, B. Hu, F. -X. Wu and Y. Pan, "Alzheimer's Disease Classification Based on Individual Hierarchical Networks Constructed With 3-D Texture Features," in *IEEE Transactions on NanoBioscience*, vol. 16, no. 6, pp. 428-437, Sept. 2017

[6] M. Liu, J. Zhang, E. Adeli and D. Shen, "Joint Classification and Regression via Deep Multi-Task Multi-Channel Learning for Alzheimer's Disease Diagnosis," in *IEEE Transactions on Biomedical Engineering*, vol. 66, no. 5, pp. 1195-1206, May 2019

[7] R. Prajapati, U. Khatri and G. R. Kwon, "An Efficient Deep Neural Network Binary Classifier for Alzheimer's Disease Classification," *2021 International Conference on Artificial Intelligence in Information and Communication (ICAIIC)*, 2021, pp. 231-234

[8] H. Fuse, K. Oishi, N. Maikusa, T. Fukami and J. A. D. N. Initiative, "Detection of Alzheimer's Disease with Shape Analysis of MRI Images," *2018 Joint 10th International Conference on Soft Computing and Intelligent Systems (SCIS) and 19th International Symposium on Advanced Intelligent Systems (ISIS)*, 2018, pp. 1031-1034

[9] Yiming Ding, Jae Ho Sohn, MD, Michael G. Kawczynski, MS, Hari Trivedi, MD,2018, A Deep Learning Model to Predict a Diagnosis of Alzheimer Disease by Using 18F-FDG PET of the Brain,IEEE Transactions, Vol.no 290, Issue 2.

[10] Lin Weiming, Gao Qinquan, Yuan Jiangnan, Chen Zhiying, Feng Chenwei, Chen Weisheng, Du Min, Tong Tong, 2020,Predicting Alzheimer's Disease Conversion from Mild Cognitive Impairment Using an Extreme Learning Machine-Based Grading Method with

Multimodal Data, Frontiers in Aging Neuroscience, vol.no 12.