IJFANS INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES
ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 12, Dec 2022

Alzheimers Disease Detection Using Cnn And Vision Transformation

Dr.P. Jeevana Jyothi[1], Department of CSE,
Vasireddy Venkatadri Institute of Technology, Nambur, Guntur Dt., Andhra Pradesh.

G. Navya Sri[2], **Ch. Annie Anuhya**[3], **B. Akhila**[4], **B. Bhanu**[5]
[2,3,4,5] UG Students, Department of CSE,
Vasireddy Venkatadri Institute of Technology, Nambur, Guntur Dt., Andhra Pradesh.
[1,2,3,4,5]jeevanajyothi.p@vvit.net, guntakanavyasri26@gmail.com,
annieanuhya689@gmail.com, akhilabollu1962002@gmail.com,
banavathbhanu2001@gmail.com

DOI:10.48047/IJFANS/V11/I12/211

Abstract

Alzheimer's disease is a brain related issue which effects the mental stability of a person. It degrades the thinking capability and targets the memory of a person.The person who is effected with the Alzheimer's finds difficult to even remember simple daily things[8].Even the very recent or latest event is also difficult for them to remember or keep track of.TheAlzheimer's disease is challenging one because there is no treatment for the disease. This disease is currently ranked as the seventh leading cause of death in the United States among older adults.There is no permanent cure or treatment for this. Thus, if the disease is predicted earlier, the progression or the symptoms of the disease can be slow down. In this paper we intend to create a model that detects Alzheimer disease using GAN and CNN.GAN can be adopted to fulfil the role of data augmentation. GANs are generative models: they create new data instances that resemble your training data. Classification process can be fulfilled by using the CNN model to the data for improving the efficiency and to ensure higher accuracy.

Keywords: CNN, GAN, Vision Transformer

Introduction

There could be many reasons for the disease. One of them is genetical occurrence, which is possible to be seen in the family members who are already effected due to the Alzheimer's. The Alzheimer's can be treated and diagnosed properly if the disease was detected at the early stages. If the disease remains untreated it slowly effects the functioning of all the crucial systems in the body moreover leads to death[7].

A person who is effected with Alzheimer's disease may not be guaranteed with permanent treatment or cure , But the living period can be extended from 4-5 years to 20 years maximum when the person is given better treatment with detection in the early stage[9].The personswho are closely related and the own family members can easily observe

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the changes in the person's behaviour or the symptoms that are really detectable. The Alzheimer's is often observed in people who are aged above 60. It is also not sure that the young people are safe and not have a chance of getting attacked by it. The studies have revealed that main cause of Alzheimer's can also be the prolonged inactive state of brain which lead to malfunctioning of it.

Role of ADNI

The ADNI stands for Alzheimer's Disease Neuroimaging Initiative , a website which contains some standard datasets of Alzheimer's disease , these consists of MRI scans of the brains in 3D structures. The researchers can find it easy to access the data and hence perform the desired analysis on how the disease is extended in the patient and know how its progression effects the patient[10]. The ADNI also helps the people who are interested in working on the way to detect and study the characteristics of the disease.The purpose of ADNI is to provide help in performing natural study of dementia and Alzheimer disease and its progression in stages.

Literature Survey

Many researches have been done on Alzheimer disease detection and classification helped in better understanding of the treatment and diagnosis to be given for the patient.

One of the researches involves the 3D RVN and CNN models to detect the disease with an accuracy of 83.27% and 84.62% respectively [1].

One of the proposed method uses modified capsule network, which takes the data as an input, makes the parent vector by considering the various features available in the OASIS dataset. The model shows the highest accuracy achieving 92.39% and lowest error rate of 7.61%[2].

Other work involves OASIS data which is taken and used for comparison of output produced by different models like XGoost , SVM , Random forest and an overview is given[3]. One of them ensured that combination of Deep triplet network and conditional triplet network is applied and the techniques CNN, ResNet, VGG are implemented out of which VGG is efficient [4].

Problem Identification

The person who is affected with AD need to be given immediate treatment in order to prevent the progression of the disease. Also, the stage of the disease should also be known for the proper diagnosis. The delay in the detection or start of treatment may increase risk of person leading to death. Hence proper and efficient algorithms need to be adopted and implemented to ensure proper results. The treatment and diagnosis results depends on the result obtained from the detection and classification itself. For this we could use deep

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learning techniques which can process and give results with high performance. Various models in deep learning can be adopted which help in producing more accurate results.

Methodology

The dataset containing the 3D MRI scan images will be taken and processed so as to undergo smooth detection process. The data augmentation is also adopted to ensure accurate results. The GAN model is used for data augmentation and the CNN model will involve the detection and classification.

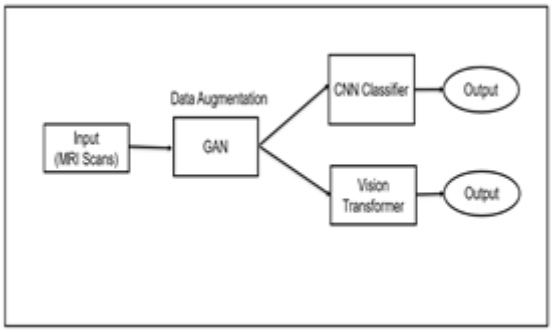

Fig.1 WorkFlow

The Fig 1. Represents the workflow which is adapted for the implementation in the detection of the Alzheimers Disease. The MRI scans which are given as raw data are now sent to be augmented using GAN which will help in increasing the performance for the deep learning techniques.The modified and augmented scans are now sent to the CNN classifier and the Vision transformer, the vision transformer divides the scan images into some patches or segments which can help in easy processing of images. Later on the outputs arecompared in terms of accuracy and performance.

Implementation

Data augmentation

Data augmentationis a technique which deals with creating modified data points which increase the amount of data by generating new data points from the data which is already existed.Some of models for data augmentation are GANs, Neural style transfer, Reinforcement learning.The dataset containing the MRI scans will be passed to the GAN in order to perform data augmentation. The modified copies of existing data are created resulting in the augmented data set, which will enhance the ease of detection of Alzheimer's disease. [11-19]

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Convolutional Neural Networks

Convolutional Neural Networks is a form of deep learning model that is motivated by the structure of animal visual cortex, are used to analyse input with a grid pattern, such as photographs. It is effective for jobs involving image processing and recognition. Convolutional layers, pooling layers, and completely connected layers are among the layers that make up this structure. The key part of a CNN is its convolutional layers, where filters are used to extract characteristics like edges, textures, and forms from the input image.

Once the augmented dataset is ready we could pass the data to the CNN classifier so as to perform the detection and classification procedure on the data.

Generative Adversarial Network

A deep learning architecture called the Generative Adversarial Network (GAN) sets two neural networks against one another. GANs are designed to produce new, synthetic data that closely mimics a pre - existing data distribution[6].

One of the most well-liked and effective GAN implementations is DCGAN. ConvNets are used instead of multi-layer perceptrons in its development. Convolutional stride actually replaces max pooling in the ConvNets implementation. The layers are also not entirely connected.

Vision Transformer

The use of vision transformers in common image recognition tasks like object detection, image segmentation, picture classification, and action recognition is widespread. It is an image classification model that applies a Transformer-like architecture to different picture patches[5]. ViTs allows models to learn image structure independently since images are represented as sequences and class labels for the image are predicted.

Results & Conclusion

	Precision	Recall	F1-score	support
Mild Demented	0.70	0.89	0.78	1907
Moderate Demented	0.93	0.96	30.94	1991
Non Demented	0.87	0.75	0.81	1990
Very Mild Demented	0.76	0.63	0.69	1874
Accuracy			0.81	7762

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Macro Avg	0.81	0.81	0.81	7762
Weighted avg	0.81	0.81	0.81	7762

Alzheimer's disease is classified into 4 classes which are Mild Demented, Moderate Demented, Non-Demented, Very Mild Demented.

The accuracy obtained from vision transformer model is 81%.

Table1.Classification Report for VIT model

The below figure 2 showing dependency between training accuracy and validation accuracy with respect to the number of epoch is as shown below

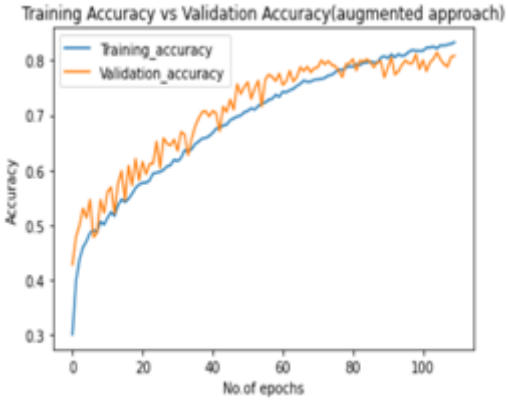

Fig.2 Training Vs Validation Accuracy for VIT model

The training and validation accuracy depends on the number of epochs which are decided. More the number of epochs, higher the training and validation accuracy for the model.

	Precision	Recall	F1-score	support
Non Demented	0.99	0.88	0.93	639
Very Mild Demented	1.00	1.00	1.00	635
Mild Demented	0.75	0.97	0.85	662
Moderate Demented	0.91	0.75	0.82	624
Micro avg	0.90	0.90	0.90	2560
Macro avg	0.91	0.90	0.90	2560
Weighted avg	0.91	0.90	0.90	2560
Samples avg	0.90	0.90	0.90	2560

Table 2. Classification report for CNN

The Table 2 shows the classification report of CNN model for the Alzheimer's Disease.

	Accuracy	Precision	Recall	F1-score
CNN	0.942	0.943	0.942	0.943
VIT	0.806	0.814	0.806	0.802

Table 3. CNN Vs VIT

The Table 3 clearly shows that the CNN model outperforms the Vison Transformer.
The CNN model gives accuracy of 94% and VIT shows an accuracy of 81%.

Future scope

The proposed models are accurate however, the GAN technique takes a lot of time for execution which also requires data augmentation as a mandatory task.
CNN alone cannot guarantee the accurate results, it can be ensembled with some other model which is a bit complex.
Moreover, the ordinary datasets also do not provide the right way to perform research. Hence, ADNI datasets should be used for the proper training and detection of disease with the test data. The 3D MRI scans that are provided in ADNI datasets ensure more capability in processing the brain structures and helps in easy detection and classification of Alzheimer.

References

[1] [1] Kavitha C., Mani Vinodhini, Srividhya S. R., Khalaf Osamah Ibrahim, Tavera Romero Carlos Andrés, "Early-Stage Alzheimer'sDisease Prediction Using Machine Learning Models", in Frontiers in Public Health , vol.10, ISSN 2296-2565, doi:10.3389/fpubh.2022.853294

[2] [2] Fatih Altay, Guillermo Ramon Sanchez, Yanli James, Stephen V. Faraone, Senem Velipasalar, Asif Salekin, "Preclinical Stage Alzheimer's Disease Detection Using Magnetic Resonance Image Scans", in arXiv:2011.14139 [eess.IV],https://doi.org/10.48550/arXiv.2011.14139

[3] [3] S. Basheer, S. Bhatia and S. B. Sakri, "Computational Modeling of Dementia Prediction Using Deep Neural Network: Analysis on OASIS Dataset," in IEEE Access, vol. 9, pp. 42449-42462, 2021, doi: 10.1109/ACCESS.2021.3066213.

[4] [4] Maysam Orouskhani, Chengcheng Zhu, Sahar Rostamian, Firoozeh Shomal Zadeh, Mehrzad Shafiei, Yasin Orouskhani, Alzheimer's disease detection from structural MRI

using conditional deep triplet network, Neuroscience Informatics, Volume 2, Issue 4, 2022, 100066, ISSN 2772-5286,https://doi.org/10.1016/j.neuri.2022.100066.

[5] [5] Yanjun Lyu, Xiaowei Yu, Dajiang Zhu, Lu Zhang and and for the Alzheimer's Disease Neuroimaging Initiative*. 2022. Classification of Alzheimer's Disease via Vision Transformer: Classification of Alzheimer's Disease via Vision Transformer. 8Pages. **https://doi.org/10.1145/3529190.3534754**

[6] [6] LaMontagne, P. J.; Benzinger, T. L.; Morris, J. C.; Keefe, S.; Hornbeck, R.; Xiong, C.;Grant, E.; Hassenstab, J.; Moulder, K.; Vlassenko, A.; et al. 2019. OASIS-3: longitudinal neuroimaging, clinical, and cognitive dataset for normal aging and Alzheimerdisease. medRxiv .

[7] [7] Khan P, Kader MF, Islam SR, Rahman AB, Kamal MS, Toha MU, et al. Machine learning and deep learning approaches for brain disease diagnosis: principles and recent advances. IEEE Access. (2021) 9:37622–55. doi: 10.1109/ACCESS.2021.3062484

[8] [8] J. Islam, Y. Zhang Brain MRI analysis for Alzheimer's disease diagnosis using an ensemble system of deep convolutional neural networks Brain Inform., 5 (2018), p. 2

[9] [9] A. Farooq, S. Anwar, M. Awais, S. Rehman "A deep CNN based multi-class classification of Alzheimer's disease using MRIProceedings" of the 2017 IEEE International Conference on Imaging Systems and Techniques, 18–20 October, IST, Beijing, China (2020)

[10] [10] Dubois B, Feldman HH,Jacova C,Dekosky ST, Barberger-Gateau P, CummingsJ, et al.Research criteria
For the diagnosisof theAlzheimer's disease: revising the NINCDS-ADRDA criteria. Lancet Neurology. 2007;6:734 734–46. 10.1016/S1474-4422(07)701 78-3.

[11] Sri Hari Nallamala, et al., "A Literature Survey on Data Mining Approach to Effectively Handle Cancer Treatment", (IJET) (UAE), ISSN: 2227 – 524X, Vol. 7, No 2.7, SI 7, Page No: 729 – 732, March 2018.

[12] Sri Hari Nallamala, et.al., "An Appraisal on Recurrent Pattern Analysis Algorithm from the Net Monitor Records", (IJET) (UAE), ISSN: 2227 – 524X, Vol. 7, No 2.7, SI 7, Page No: 542 – 545, March 2018.

[13] Sri Hari Nallamala, et.al, "Qualitative Metrics on Breast Cancer Diagnosis with Neuro Fuzzy Inference Systems", International Journal of Advanced Trends in Computer Science and Engineering, (IJATCSE), ISSN (ONLINE): 2278 – 3091, Vol. 8 No. 2, Page No: 259 – 264, March / April 2019.

[14] Sri Hari Nallamala, et.al, "Breast Cancer Detection using Machine Learning Way", International Journal of Recent Technology and Engineering (IJRTE), ISSN: 2277-3878, Volume-8, Issue-2S3, Page No: 1402 – 1405, July 2019.

[15] Sri Hari Nallamala, et.al, "Pedagogy and Reduction of K-nn Algorithm for Filtering Samples in the Breast Cancer Treatment", International Journal of Scientific and Technology Research, (IJSTR), ISSN: 2277-8616, Vol. 8, Issue 11, Page No: 2168 – 2173, November 2019.

[16] Kolla Bhanu Prakash, Sri Hari Nallamala, et al., "Accurate Hand Gesture Recognition using CNN and RNN Approaches" International Journal of Advanced Trends in Computer Science and Engineering, 9(3), May – June 2020, 3216 – 3222.

[17] Sri Hari Nallamala, et al., "A Review on 'Applications, Early Successes & Challenges of Big Data in Modern Healthcare Management'", Vol.83, May - June 2020 ISSN: 0193-4120 Page No. 11117 – 11121.

[18] Nallamala, S.H., et al., "A Brief Analysis of Collaborative and Content Based Filtering Algorithms used in Recommender Systems", IOP Conference Series: Materials Science and Engineering, 2020, 981(2), 022008.

[19] Nallamala, S.H., Mishra, P., Koneru, S.V., "Breast cancer detection using machine learning approaches", International Journal of Recent Technology and Engineering, 2019, 7(5), pp. 478–481.