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"A Review on - Alzheimer Disease Detection Using Deep Learning"

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***Abstract* - Alzheimer's and related diseases are significant health issues of this era. The interdisciplinary use of deep learning in this field has shown great promise and gathered considerable interest. This paper surveys deep learning literature related to Alzheimer's disease, mild cognitive impairment, and related diseases from 2010 to early 2023.Alzheimer's disease poses a significant global health challenge, demanding innovative approaches for early diagnosis and effective treatment. This comprehensive review explores the evolving landscape of deep learning applications in Alzheimer's disease research, focusing on its role in imaging data analysis. Beginning with an introduction to Alzheimer's disease and the current diagnostic landscape, we delve into the fundamentals of deep learning, elucidating neural network architectures and learning mechanisms. The review provides a detailed examination of various imaging modalities, such as MRI, PET, and CT scans, used in Alzheimer's research, emphasizing the limitations of conventional analysis methods.**

***Keywords*-- Alzheimer's disease, Dementia, Detection, Recognition, Deep Learning, MRI**

I. INTRODUCTION

Alzheimer's disease (AD) is a type of incurable brain disease due to neurodegeneration. AD is present worldwide. AD is characterized by β-amyloid (Aβ), which contains extracellular plaques and tau-containing intracellular neurofibrillary tangles .Cognitive ability disorder is the major symptom due to AD. This disease is more prevalent in aged people, normally affecting those aged 65 or older; 10% of cases are early onset occurring in people younger than 65. AD also affects language, attention, comprehension, reasoning, and memory. Professionals can take care of patients suffering from this disease's symptoms.

The decline in cognitive ability occurs due to dementia which impacts daily activities.

AD is the most common type of dementia, accounting for about two-thirds of the cases due to age factors. In 2020, AD was the seventh leading cause of death in the United States of America. AD has some treatments to improve the symptoms, but there is no proper treatment to recovery.AD types are classified as Non-Dementia, Very-Mild Dementia, Mild Dementia, and Moderate Dementia. According to AD analysis, these stages are defined according to other research techniques and are different from the DSM-5 classification of AD. Symptoms of AD depend upon the stage of the disease. Themost common and very first symptom is short-term memory loss. Also, a language disorder is common in AD patients.

II. ALZHEIMER'S DISEASE

Alzheimer's disease begins with mild memory loss and can leadto loss of the ability to carry on a conversation and respond to the environment. In most people, symptoms first appear later inlife. The time from diagnosis to death varies, but may be as little as three or four years if the person is older than 80 when diagnosed, to as long as 10 or more years if the person is younger.

Alzheimer's disease is not a normal part of aging. It's the resultof complex changes in the brain that start years before symptomsappear and lead to the loss of brain cells and their connections. There is no treatment that cures Alzheimer's disease, but medicines may improve or slow the progression of symptoms. Acetylcholinesterase (AChE) inhibitors, such as donepezil, galantamine, and rivastigmine, can be prescribed for people with early- to mid-stage Alzheimer's disease.

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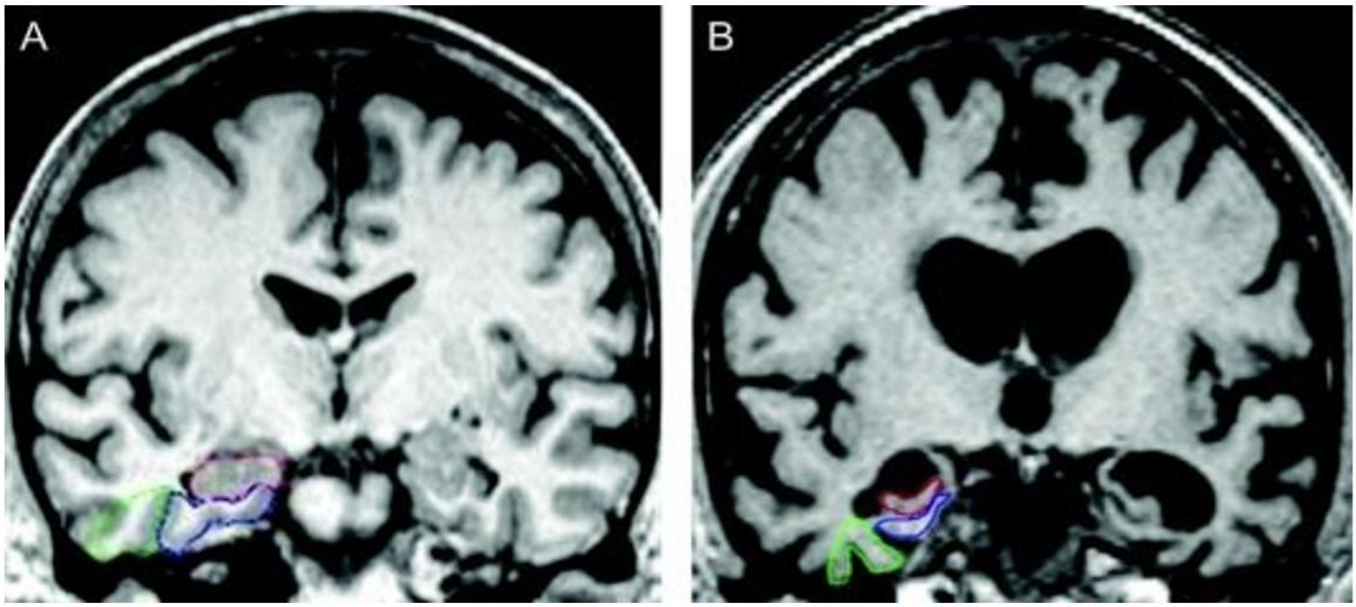

Fig 1: Alzheimer's disease

III. OBJECTIVE

- To capture different aspects of the disease.
- To improve, stabilize, or slow the cognitive, functional, and behavioral decline.
- To improve quality of life for people with dementia and their caregivers.
- To identify the stage of Alzheimer's Disease (AD) patients
- through the use of mobility data and deep learning models

IV. METHOD

With the continuous progress of technology, deep learning method has become the preferred method for analysing medical images, which provides a new idea to solve the problems of traditional machine learning in medical image classification. The deep learning method draws lessons from the field of computer vision, and then is widely used in medical image analysis. The deep learning technology and its architecture are unsupervised learning, supervised learning and so on. The early stage of AD will only cause fine structural changes in the brain. Without any AD classification guidance, it is difficult to train the traditional end-to-end CNN model.

Therefore, relying on domain knowledge and the experience of relevant experts, most of the existing CNN based methods empirically determine the information area (such as hippocampus or patch) to build a diagnostic model in MRI, which may hinder the effectiveness of deep neural network in brain disease diagnosis. Compared with traditional methods, deep learning models can automatically learn image features for AD classification, it has superior diagnostic performance. If deep learning technology can accurately detect AD, more research is needed.

V. HARDWARE AND SOFTWARE

- *Software:* Data processing, feature extraction, and model creation were performed using the Python programming language and libraries from TensorFlow, Keras, Scikit-learn, and Pandas:
- *Tensor Flow* is an open-source software library for numerical computation using data flow graphs. It is used for machine learning and deep learning. TensorFlow was developed by the Google Brain team and released in 2015. It is available for Python, C++, Java, and Go.

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- *Keras* is a high-level neural networks API, written in Python, which can run on top of TensorFlow, CNTK, or Theano. It is designed to enable fast experimentation with deep learning models. Keras was developed by François Chollet, a Google engineer, and released in 2015.
- *Scikit-learn* is a free software machine learning library for Python. It features various classification, regression, clustering and dimensionality reduction algorithms including support vector machines, random forests, gradient boosting, k-means and DBSCAN. It is distributed under the 3-clause BSD license. Pandas is a free and open-source software library, written for the Python programming language, for data manipulation and analysis. In particular, it offers data structures and operations for manipulating numerical tables and time series
- *Hardware:* TO speed up the training and testing processes, computationally demanding tasks were carried out on high- performance computing cluster or GPUs.
- For small to medium-sized projects, a high-performance GPU can significantly speed up training times compared to using just a CPU. NVIDIA GPUs, especially those in the RTX or A-series, are popular choices due to their excellent performance in deep learning

VI. From ML To DL In AD

ML has been used in the past decade to detect the MRI biomarker of AD.

Many ML method are currently utilised to improve the determination and prediction of AD. A precise categorisation of stable MCI versus progressive MCI was achieved by Haller et al. by analysing 35 cases of normal control and 67 cases of MCI with a support vector machine (SVM). Segmentation has been emphasised in most ML processes for bio-image classification, whereas the retrieval of strong texture descriptions has generally been neglected. Machine learning (ML) and deep learning have been used to diagnose Alzheimer's disease with success in recent years. Different models of ML have achieved different accuracy, sensitivity, specificity, and precision. For example, one study found that the multi-model deep learning + RNN model achieved an accuracy of 81%. ML models can help identify people who are at risk of Alzheimer's disease (AD). The early diagnosis of MCI and its subtypes can lead to early intervention, which can profoundly impact patient longevity and quality of life.

VII. Testing Result

The performance of the AD image detection system has been carried out on the open access Kaggle Alzheimer's Classification Dataset (KACD). This KACD dataset consists of 6400 brain MRI images with license free access properties. These images were split into training set and test set.

The training set of this dataset consists of 5121 brain MRI images (2560 Non-AD brain images and 2561 CE brain images) and the test set consists of 1279 brain images (640 Non-AD brain images and 639 CE brain.

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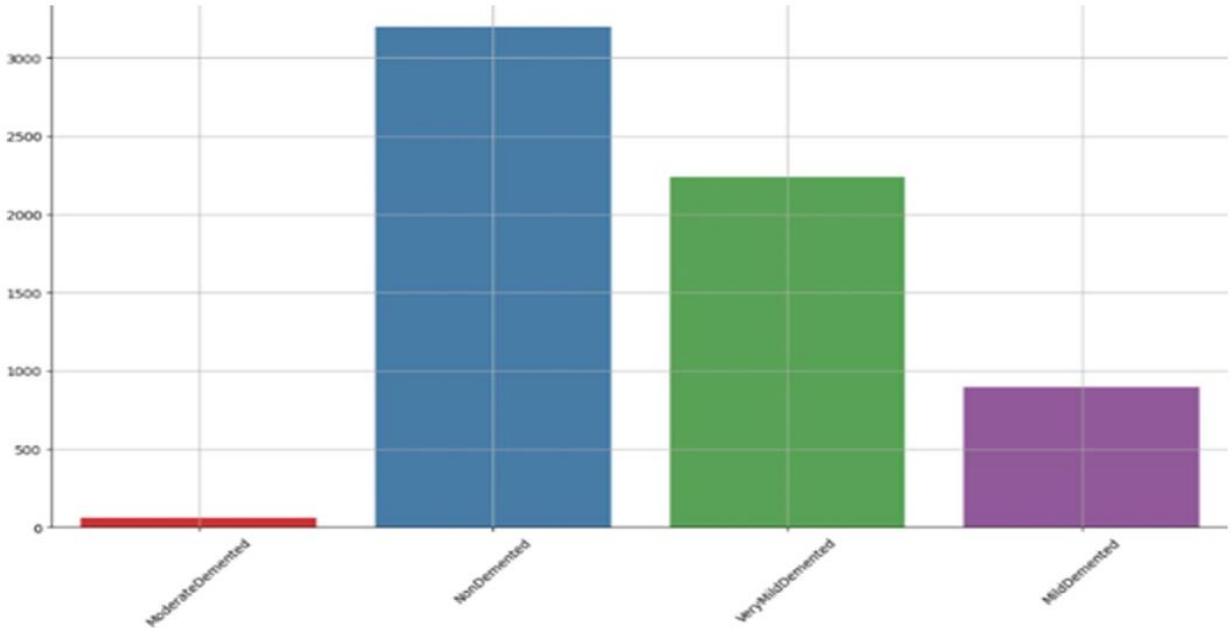

Fig. 2: The Number of Samples for Each Class

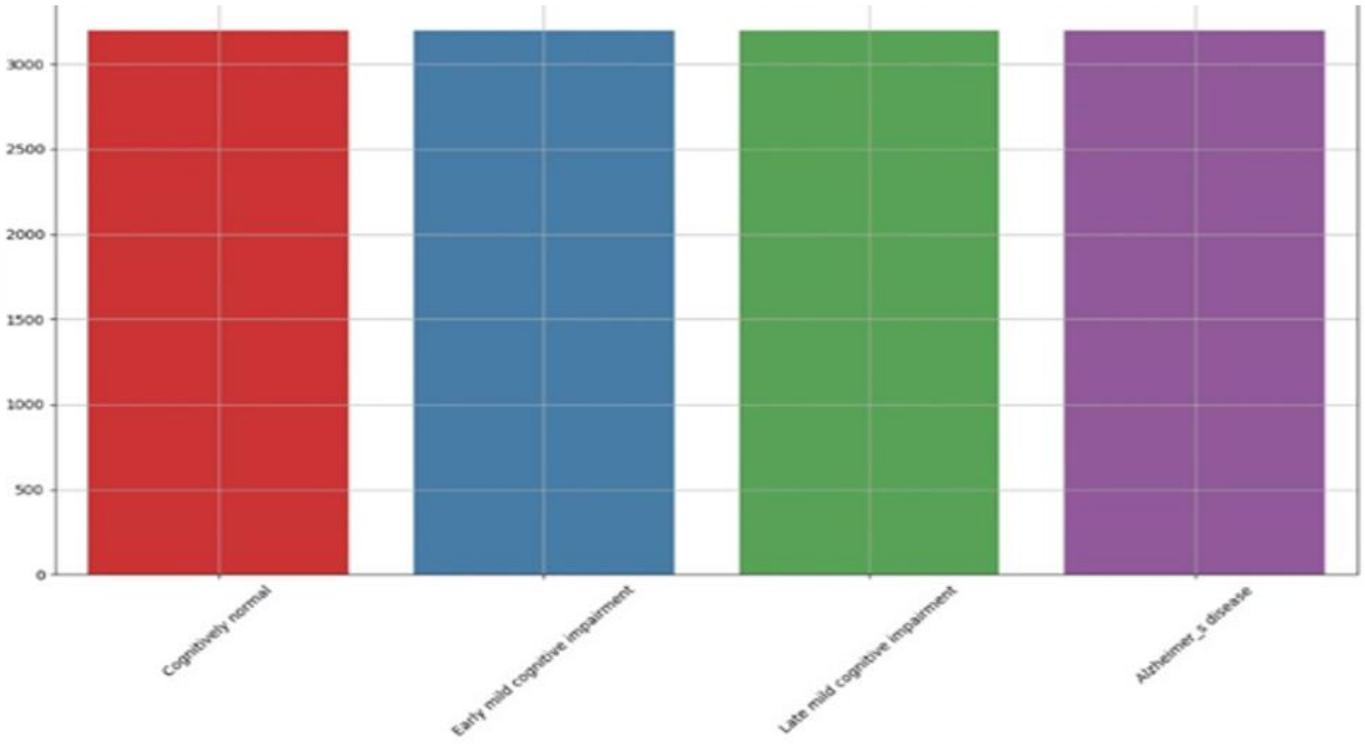

Fig. 3: The Number of Samples for Each Class

VIII. Conclusion

In conclusion, Early detection of AD has always been a challenging task, and related computer researchers are also constantly exploring. This paper mainly introduces the biomarkers related to AD, the preprocessing method, feature extraction method and the application of depth model in AD diagnosis. In terms of classification methods, CNN is used most frequently and has better performance in this field compared with other deep models. However, the overfitting problem related to the data set still needs to be solved.

Due to the limited medical data, unsupervised and self-monitoring methods are emerging research fields in medical images. Although most of the challenges in the field of AD classification have not been solved, the success of deep learning technology cannot be ignored. Under certain circumstances, its AD detection is superior to medical experts. In the future, we will continue to explore AD diagnosis methods on the basis of deep learning.

REFERENCES

[1] Knopman et al. (2021) Knopman DS, Amieva H, Petersen RC, Chételat G, Holtzman DM, Hyman BT, Nixon RA, Jones DT. Alzheimer disease. Nature Reviews Disease Primers. 2021;7(1):1–21. doi: 10.1038/s41572-021-00269-y.

[2] Kumar et al. (2018) Kumar A, Sidhu J, Goyal A, Tsao JW. Alzheimer disease. StatPearls. 2018. [4 December 2022]. pp. 1– 27

[3] Frozza, Lourenco & De Felice (2018) Frozza RL, Lourenco MV, De Felice FG. Challenges for Alzheimer's disease therapy: insights from novel mechanisms beyond memory defects. Frontiers in Neuroscience. 2018;12:37. doi: 10.3389/fnins.2018.00037.

[4] New York ,USA, Cambridge University Press. Stephen, R, Hongisto, K, Solomon, A, & Lonnroos, E Physical Activity and Alzheimer's Disease: A Systematic Review. J Gerontol A Biol Sci Med Sci, 2017; 72(6): 733-739.

[5] Sydenham, E, Dangour, A D, & Lim, W S Omega 3 fatty acid for the prevention of cognitive decline and dementia. Cochrane Database Syst Rev 2012; (6): CD005379.

[6] Venkatesan, R, Ji, E, & Kim, S Y Phytochemicals that regulate neurodegenerative disease by targeting neurotrophins: a comprehensive review. Biomed Res Int, 2015; 814068.

[7] Winner, B, Kohl, Z, & Gage, F H Neurodegenerative disease and adult neurogenesis. Eur J Neurosci, 2011; 33(6): 1139-1151.

[8] Yan, R, & Vassar, R Targeting the beta secretase BACE1 for Alzheimer's disease therapy. Lancet Neurol, 2014; 13(3): 319-329.

[9] Alzheimer's Association. (2021). Alzheimer's disease facts and figures. Alzheimer's & Dementia, 17(3), 327-406.

[10] Liu, S., Liu, S., Cai, W., & Pujol, S. (2014). Early diagnosis of Alzheimer's disease with deep learning. IEEE Transactions on Pattern Analysis and Machine Intelligence, 38(6), 990-1000.

[11] Smith, S. M., & Nichols, T. E. (2009). Threshold-free cluster enhancement: addressing problems of smoothing, threshold dependence and localisation in cluster inference. Neuroimages, 44(1), 83-98.

[12] Chen, R., Herskovits, E. H., & Bammer, R. (2010). Magnetic resonance image tissue classification using a partial volume model. NeuroImage, 53(1), 130-138.

[13] Alzheimer's Disease Neuroimaging Initiative. (2010). The Alzheimer's Disease Neuroimaging Initiative: A review of papers published since its inception. Alzheimer's & Dementia, 8(1), S1-S68.

[14] Hosseini-Asl, E., & Keynton, R. S. (2016). Alzheimer's disease diagnostics by a 3D deeply supervised adaptable convolutional network. arXiv preprint arXiv:1607.00556.

[15] Hinton, G., Deng, L., Yu, D., Dahl, G. E., Mohamed, A. R., Jaitly, N., ... & Kingsbury, B. (2012). Deep neural networks for acoustic modeling in speech recognition: The shared views of four research groups. IEEE Signal Processing Magazine, 29(6), 82-97.

[16] Boeve, B.F.; Boxer, A.L.; Kumfor, F.; Pijnenburg, Y.; Rohrer, J.D. Advances and controversies in frontotemporal dementia: Diagnosis, biomarkers, and therapeutic considerations. Lancet Neurol. 2022, 21, 258–272.

[17] Sügis, E.; Dauvillier, J.; Leontjeva, A.; Adler, P.; Hindie, V.; Moncion, T.; Collura, V.; Daudin, R.; Loe-Mie, Y.; Herault, Y.; et al. HENA, heterogeneous network-based data set for Alzheimer's disease. Sci. Data 2019, 6, 151.

[18] Wimo, A.; Jönsson, L.; Bond, J.; Prince, M.; Winblad, B.; Alzheimer Disease International. The worldwide economic impact of dementia 2010. Alzheimer's Dement. 2013, 9, 1– 11.e3.

[19] López-Cuenca, I.; Nebreda, A.; García-Colomo, A.; Salobrar-García, E.; de Frutos-Lucas, J.; Bruña, R.; Ramírez, A.I.; Ramirez-Toraño, F.; Salazar, J.J.; Barabash, A.; et al. Early visual alterations in individuals at-risk of Alzheimer's disease: A multidisciplinary approach. Alzheimer's Res. Ther. 2023, 15, 19.

[20] Toschi, N.; Baldacci, F.; Zetterberg, H.; Blennow, K.; Kilimann, I.; Teipel, S.J.; Cavedo, E.; dos Santos, A.M.; Epelbaum, S.; Lamari, F. Alzheimer's disease biomarker- guided diagnostic workflow using the added value of six combined cerebrospinal fluid candidates: Ab1–42, total-tau, phosphorylated-tau, NFL, neurogranin, and YKL-40. Alzheimer's Dement. 2017, 1, 10.

[21] Scheltens, P.; Blennow, K.; Breteler, M.M.B.; de Strooper, B.; Frisoni, G.B.; Salloway, S.; Van der Flier, W.M. Alzheimer's disease. Lancet 2016, 388, 505–517.

[22] Vogt, A.-C.S.; Jennings, G.T.; Mohsen, M.O.; Vogel, M.; Bachmann, M.F. Alzheimer's Disease: A Brief History of Immunotherapies Targeting Amyloid β. Int. J. Mol. Sci. 2023, 24, 3895.

[23] Van der Lee, S.J.; Wolters, F.J.; Ikram, M.K.; Hofman, A.; Ikram, M.A.; Amin, N.; van Duijn, C.M. The effect of APOE and other common genetic variants on the onset of Alzheimer's disease and dementia: A community-based cohort study. Lancet Neurol. 2018, 17, 434–444.

[24] Fortea, J.; Vilaplana, E.; Carmona-Iragui, M.; Benejam, B.; Videla, L.; Barroeta, I.; Fernández, S.; Altuna, M.; Pegueroles, J.; Montal, V. Clinical and biomarker changes of Alzheimer's disease in adults with