ALZHEIMER'S DISEASE DETECTION AND CLASSIFICATION

Team Members:

- Tamilarasee Sethuraj
  A20553416
- Krishnavardhini Kittusamy
  A20502176

Problem description

Alzheimer's disease (AD) is the most common type of Dementia, a neurodegenerative brain disease that can significantly affect the quality of life of older individuals. The commonly used method is to predict the disease based on Magnetic Resonance Imaging (MRI) for the purpose of early intervention. Although there is no cure for Alzheimer's, there are medications and interventions to manage symptoms and slow down the progression to some extent. Early treatment proves to be an effective way of preventing its deterioration.

The advancements in technology have had a profound impact on healthcare, revolutionizing various aspects of the industry. ML algorithms can integrate and analyze diverse data types, including neuroimaging, biomarkers, and clinical information. This holistic approach provides a comprehensive view of the patient's condition, aiding in accurate diagnosis. The creation of classification models based on AD risk factors using machine learning techniques is a promising tool to minimize the impact of under-diagnosis. The focus of the problem is to identify subtle changes in cognitive function that may indicate the severity of AD which would help providers for making informed decisions about patient care and early treatment.

Brief survey of existing work

Many scientists have made sincere efforts to discover a variety of techniques to detect Alzheimer's using MRI data. Those techniques include the extraction of discriminative features from a large set of features, and selecting efficient classification models from machine techniques. While most of the early techniques deploy binary classification of finding whether the given MRI image is subject to AD or not, there are some recent techniques which focus on finding the current stage/severity of the disease such as very mildly demented, mildly demented, moderately demented.

There are several methods explored by scholars to classify the MRI images such as Principle Component Analysis(PCA), K-means Clustering, Linear Discriminant Analysis(LDA), Support Vector Machine, VGG19/XGBoost, EfficientNet, deep learning-based approaches like Convolutional Neural Networks (CNNs).

Some of the difficulties that scientists have faced in implementing the models are extracting clear image features that show small variants of brain cells changes, using complex models restricts the ability to provide relevant information based on which the decision was made (classification). It is important to know the logics/root of the decision as it involves patient care and hence, we may need to rely on simple explainable models which may not have much scope for accuracy or improvement.

Concise overview of suggested work

We will explore different algorithms for AD detection and severity classification, such as Logistic Regression, SVM, GaussianNB, VGG19/XGBoost, Randomforest, KNN and CNN. Compare the performance of the approaches and identify the most efficient method. Explore other features that could be imparted into the method to enhance the existing method and to ensure high accuracy and reliability.

We aim to update parameters of the efficient model to allow for traceability of decisions, ensuring it is transparent and suitable for clinical purposes.

Overall, the goal of the proposed system is to improve Alzheimer's Disease classification, making it more efficient and accurate for easier integration into clinical practices, ultimately benefiting patient care.

Preliminary Plan

1. Conduct a literature review of existing approaches and various methods of classification.
2. Gather a dataset containing MRI images and their associated ground truth data
3. Implement and compare the various ML algorithms to determine the most effective method.
4. Identify scope for improvement and improve the model to enhance transparent decision-making.
5. Incorporate any features that may aid in the early detection of Alzheimer's to enhance patient care
6. Compile a report summarizing the findings and conclusions

References

- A deep learning model for Alzheimer’s disease diagnosis based on patient clinical records https://www.sciencedirect.com/science/article/abs/pii/S0010482523012799
- Bharath M; Gowtham S ; Rohini B R - Predicting Alzheimer’s Disease Progression through Machine Learning Algorithms - 2023 International Conference on Recent Advances in Science and Engineering Technology (ICRASET)
- https://www.researchgate.net/publication/322584207_A_deep_CNN_based_multi-class_classification_of_Alzheimer's_disease_using_MRI
- Comparative study of detection and classification of Alzheimer's disease using Hybrid model and CNN - https://ieeexplore.ieee.org/document/9688082 - 2021 International Conference on Disruptive Technologies for Multi-Disciplinary Research and Applications (CENTCON)
- https://www.researchgate.net/publication/378090880_Application_and_comparison_of_K-means_and_PCA_based_segmentation_models_for_Alzheimer_disease_detection_using_MRI
- Eke, Chima S., et al. "Early detection of Alzheimer's disease with blood plasma proteins using support vector machines." IEEE journal of biomedical and health informatics 25.1 (2020)