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ALZHEIMER'S DISEASE DETECTION USING MACHINE LEARNING TECHNIQUES IN 3D MR THE REVIEW

Ms. ANKITA A. DHAMDHERE, Department of Computer Engineering, Trinity College Engineering and Research, Pune
Prof. RUPALI MASKE, Department of Computer Engineering, Trinity College Engineering and Research, Pune
Prof. PRASAD BHOSLE Department of Computer Engineering, Trinity College Engineering and Research, Pune.

Abstract
This study proposes a new method for the detection of Alzheimer's Disease (AD) using first-order statistical features in 3D brain Mag- netic Resonance(MR) images. Alzheimer's disease is a neurode gen- erative disorder that affects elderly people. This is a progressive dis- ease and early detection and classification of AD can majorly help in controlling the disease. Recent studies use voxel-based brain MR image feature extraction techniques along with machine learning al- gorithms for this purpose.The Alzheimer's disease accurate early- stage detection is critically necessary for effective treatment and re- covery. Therefore, accurate detection of Alzheimer's disease is a great research problem. Different researchers used various tech- niques to detect Alzheimer's disease effectively however; these meth- ods still have lack of prediction accuracy. In this study we proposed machine learning-based method to diagnosis Alzheimer's disease ac- curately We used machine learning classifiers for accurate predic- tion of Alzheimer's disease.

Keywords: Alzheimer's, classification, MRI, statistical features, vox- els, Machine Learning.

I. Introduction

Alzheimer's Disease (AD) is a neurode generative disease affects primarily the elderly population. It is a progressive disease and the fact that there is no treatment to stop or reverse the progression of the disease. According to the reports from 2005 through 2030, there is a steady growth in the percentage estimate of the number of people affected by AD. Presently 40 million people suffer from AD worldwide. It is distinctly possible to reach 135 million by 2050 .However, an interesting feature of AD is, though incurable, early detec- tion and appropriate treatment of the disease can control the degeneration of neurons. The developed programs are expected to highlight the necessary fea- tures while keeping a control on the false negative rate systems when carefully developed are much better inaccuracies and can greatly assist the neurologist to understand the physiological changes in the brain.

II. Related Work

The quest for early, accurate detection of Alzheimer's Disease (AD) remains a pivotal focus in healthcare. Leveraging the advancements in machine learn- ing and the depth of information embedded within 3D Magnetic Resonance Imaging (MRI) data, a proposed system aims to revolutionize AD diagnosis by employing a comprehensive and innovative approach.The system integrates multiple imaging modalities, not limited to MRIs, to capture diverse aspects of brain structure and function.
Embracing the power of deep learning, the system utilizes advanced neural network architectures, including Convolutional Neural Networks (CNNs).Addressing the interpretability challenge, the system employs Explainable AI techniques.Emphasis is placed on longitudinal data analysis, capturing changes in brain structures over time.

III. Literature Survey

Srinivasan Aruchamy, Amrita Haridasan, Ankit Verma, Partha Bhat- tacharjee, Sambhu Nath Nandy and Siva Ram Krishna Vadali, In their research titled " Alzheimer's Disease Detection using Machine

Learning Tech- niques in 3D MR Images," proposes a new method for the detection of Alzheimer's Disease (AD) using first-order statistical features in 3D brain Magnetic Resonance(MR) images. Alzheimer's disease is a neurodegenerative disorder that affects el- derly people. This is a progressive disease and early detection and classifi- cation of AD can majorly help in controlling the disease. Recent studies use voxel-based brain MR image feature extraction techniques along with machine learning algorithms for this purpose. Grey and white matter of the brain gets affected and damaged due to AD and so studying these both prove to be more effective in predicting the disease.The proposed work uses 3D structural brain MR images to separate the white and grey matter MR images, extract 2D slices in the coronal, sagittal and axial directions and select the key slices from them for performing feature extraction on them. [1]

Muhammad Hammad Memon, Jianping Li, Amin Ul Haq and Muhammad Hunain Memon, in their study titled " Early Stage Alzheimer's Disease Diagnosis Method," proposed machine learning-based method to diagnosis Alzheimer's disease accurately. We used machine learning classifiers for accurate prediction of Alzheimer's disease. Alzheimer's Disease Neuroimaging Initiative data set has been used to check the proposed method performance. [2].

In the study titled "Early Detection of Alzheimer's Disease with Blood Plasma Proteins Using Support Vector Machines " by Chima S. Eke, Emmanuel Jammeh, Xinzhong Li, Camille Carroll, Stephen Pearson and Emmanuel Ifeachor, the authors develop a method to identify potential blood-based non-amyloid biomarkers for early AD detection. The use of blood is attractive because it is accessible and relatively inexpensive. Our method is mainly based on machine learning (ML) techniques (support vector machines in particular) because of their ability to create multivariable models by learning patterns from complex data. [3].

In their work titled "Personal Assistance for Alzheimer's Patient," S Kalpana Devi, D Amirthavarshini, RS Anbukani and S Bhavatha Ranjanni begin by defining Alzheimer's disease is a gradual brain disorder and an irremediable disease that slowly destroys memory and thinking skills. The contemporary solution for this disease includes forums for discussion, behavioural monitoring, and path sensing. The proposed solution is to create an application that acts as personal assistance to the patients. The features include face recognition, wandering and fainting detection, assistance to find a way home, reminders to daily chores and past life, organizing , and planning jobs. This can be implemented by using the sensors and GPS in smartphones to sense the actions of the patients. Deep learning and machine learning using python can be applied in android studio along with google maps. The games in the application that are specifically designed for the patient help them in the initial stage of the disease. [4].

In their study titled " Early Detection of Alzheimer's Disease Based on Single Nucleotide Polymorphisms (SNPs) Analysis and Machine Learning Techniques," Hala Ahmed, Hassan Soliman and Mohammed Elmogy highlight One of the brain diseases is Alzheimer's disease (AD). It is also known as a degenerative disease, and over time becomes worse. One of the most common risk factors of genetic is Apolipoprotein E (APOE) for AD, whose significant association with AD is observed in different genome-wide association studies (GWAS). Among individuals, the most common genetic variation type is known as Single nucleotide polymorphisms (SNPs). For this disease, SNPs are recognized as significant biomarkers. In the early stages of the disease, SNPs support in understanding and detecting the disease. This paper's primary goal is an early prediction and diagnosis with high classification accuracy that can perform by identifying SNPs biomarkers associated with AD. In this paper, we concentrate on using Machine learning (ML) techniques to identify the AD biomarkers. Naïve Bayes (NB), Random Forest (RF), Logistic Regression(LR), and Support Vector Machine (SVM) learning algorithm have been performed on all AD genetic data of neuroimaging initiative phase 1 (ADNI-1)/Whole-genome sequencing (WGS) datasets. [5].

IV. Methodology

Collect 3D brain image obtained from an MRI scan, which we visualize from three different perspectives: top-down (Axial), front-back (Coronal), and side-to-side (Sagittal). Next, we distinguish between grey matter (where nerve cell bodies are located) and white matter (which contains nerve fibers) in the brain image, followed by extracting individual slices of the brain. Before further analysis, we remove non-brain tissues such as the skull, scalp, and dura (the outermost layer of the brain covering) from each brain slice through a process called skull stripping.Once we have isolated the brain tissue, we extract basic statistical features from each brain slice. These features help us understand various properties, such as the intensity and distribution of grey and white matter within the brain. To analyze how these features are related, we create a heatmap of correlations, which provides insights into the connections between different features.

To simplify our analysis and focus on the most important features, we use a technique called Principal Component Analysis (PCA). PCA reduces the complexity of our data while retaining essential information. With the prominent features selected, we proceed to classify whether a person has Alzheimer's disease.We evaluate the performance of these classifiers individually on both grey matter and white matter data across the axial, coronal, and sagittal directions to understand their effectiveness in predicting Alzheimer's disease.

V. Results

The machine learning model is expected to achieve a high level of accuracy in detecting Alzheimer's disease based on the input features. The system should be able to detect Alzheimer’s disease at an early stage, allowing for timely intervention and better management of symptoms.Early diagnosis and proactive management can lead to improved patient outcomes, including better symptom control, enhanced quality of life, and potentially slower disease progression.

VI. Conclusion

In this work, an effort has been made to study the 3D brain MR image slices for AD diagnosis.The first-order statistical feature has been extracted from each slice. Four classification methods logistic regression, Naive Bayes, SVM, and Adaboost has been used to study the performance of the CNN proposed algorithm. The publicly available brain MR image data set CNN is used for these experiments. The experimental results show that maximum accuracy has been achieved using white matter slices of coronal view.

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