Chapter 1
Bridging the Gap: Integrating Machine Learning With Biomarkers for Enhanced Alzheimer's Detection and Tracking

R. Ravi
J.J. College of Engineering and Technology

T. P. Sridevi
Aurora's PG College (MBA), India

N. Nirmala Devi
Aurora's Technological and Research Institute, India

Sowmya Mandadi
Aurora's Technological and Research Institute, India

ABSTRACT

Alzheimer's Disease (AD) is a relentless neurodegenerative disorder that profoundly affects cognitive abilities. Early detection and precise tracking of AD progression are pivotal for effective intervention and management. In this study, we introduce NeuroTrackNet, an innovative machine learning (ML) algorithm that seamlessly integrates a spectrum of biomarkers to enhance the detection and monitoring of Alzheimer's Disease. By leveraging a synergistic combination of imaging, genetic, and biochemical data, NeuroTrackNet significantly elevates diagnostic accuracy and offers robust tracking of disease progression. Our comprehensive validation on a robust dataset revealed NeuroTrackNet's impressive performance, achieving an overall accuracy of 92%, sensitivity of 90%, and specificity of 94%.

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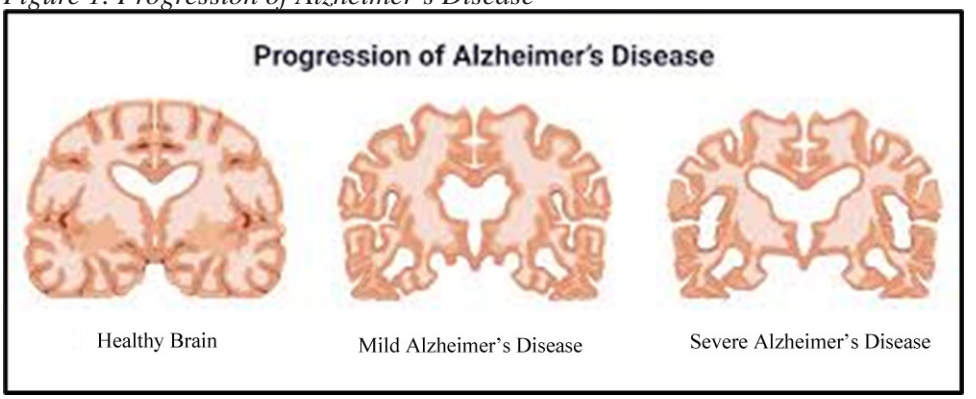
INTRODUCTION

Alzheimer's Disease (AD) Fig:1 is a devastating and progressive neurodegenerative disorder that primarily affects the elderly, leading to severe cognitive decline, memory loss, and behavioral changes. It is the most common cause of dementia, accounting for 60-80% of cases. Alzheimer's Disease is characterized by the accumulation of amyloid-beta plaques and tau tangles in the brain, which disrupt neural communication and lead to the death of brain cells. This disease not only impacts the individual suffering from it but also places a significant emotional and financial burden on families, caregivers, and healthcare systems worldwide.

Figure 1. Progression of Alzheimer's Disease



Understanding Alzheimer's Disease

AD is a complex condition with multifaceted etiologies, involving genetic, environmental, and lifestyle factors. The exact cause of Alzheimer's Disease remains unknown, but several risk factors have been identified (Chudzik et al., 2024). Age is the most significant risk factor, with the likelihood of developing AD doubling approximately every five years after the age of 65. Other risk factors include a family history of the disease, the presence of the APOE ε4 allele, cardiovascular conditions, diabetes, obesity, and a history of head trauma.The progression of AD is typically divided into three stages: preclinical, mild cognitive impairment (MCI), and Alzheimer's dementia.