# Chapter 10
# Advancing Alzheimer's Disease Detection With Big Data and Machine Learning

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## ABSTRACT

*Alzheimer's disease (AD) detection and diagnosis face challenges due to its complexity. This study explores the fusion of advanced machine learning algorithms and big data methods to improve detection accuracy. In addition to commonly used algorithms like Random Forest and Support Vector Machines, the study introduces Gradient Boosting Decision Trees (GBDT) for AD prediction. GBDT combines the strength of multiple weak learners to enhance predictive performance. Furthermore, the study implements big data techniques such as data parallelization and distributed computing to handle large-scale datasets efficiently. By leveraging these methods, the study achieves a significant improvement in computational efficiency, enabling timely analysis of extensive AD-related data. Results show that the GBDT algorithm outperforms traditional methods, achieving an accuracy of 85% in predicting AD onset and progression. When combined with big data techniques, the overall accuracy further increases to 88%.*

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## INTRODUCTION

Alzheimer's disease (AD) stands as a formidable challenge in modern healthcare, characterized by progressive cognitive decline and memory loss. (Li et al., 2023) As the most common form of dementia, it not only impacts the individual's cognitive functions but also places a substantial burden on families, caregivers, and healthcare systems worldwide. Despite decades of research, effective treatments for AD remain elusive, primarily due to its complex etiology and multifactorial nature. (Vrahatis et al., 2023) Traditional diagnostic methods heavily rely on clinical assessments and neuroimaging, which are often invasive, expensive, and time-consuming. However, the emergence of big data technologies and advanced machine learning algorithms offers a promising avenue for transforming AD detection and diagnosis. By leveraging vast datasets encompassing genetic information, medical histories, neuroimaging scans, and biomarker profiles, researchers can unravel intricate patterns and identify early indicators of AD with unprecedented accuracy and efficiency. This paper provides a comprehensive exploration of Alzheimer's disease, delving into its pathophysiology, diagnostic challenges, and current treatment strategies. (El-Latif et al., 2023) Moreover, it examines the potential of big data concepts and machine learning techniques in revolutionizing AD research and clinical practice, ultimately aiming to contribute to improved patient outcomes and more effective management of this devastating condition.

### Understanding Alzheimer's Disease

Alzheimer's disease is a neurodegenerative disorder characterized by the progressive deterioration of cognitive functions as shown in fig:1, particularly memory, reasoning, and language. It typically manifests in older adults, although early-onset cases can occur. (Brem et al., 2023) The pathological hallmarks of AD include the accumulation of beta-amyloid plaques and tau protein tangles in the brain, leading to neuronal damage and eventual cell death. These pathological changes disrupt neuronal communication and synaptic function, resulting in cognitive decline and memory loss. The exact cause of AD remains elusive, although a combination of genetic, environmental, and lifestyle factors likely contributes to its development. As shown Figure 1 Healthy vs Alzheimer brain

# An Experimental Investigation of Pulse Measurement by Means of a Plethysmographic Sensor Integrated in a ZigBee Medical Network

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