

P1-001

Novel Multimodal AI Framework For Alzheimer's Disease Detection, Staging, And Prognosis Using Fusion And Diffusion Models

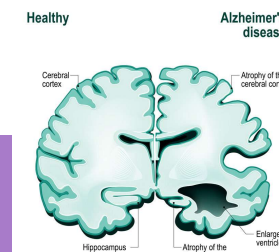
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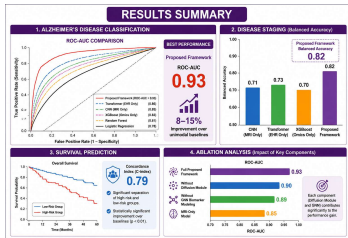
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- Unified multimodal AI framework integrating imaging, omics, electrophysiology, retinal, clinical, and digital biomarkers.
- Transformer-based fusion, Graph Neural Networks, and Diffusion Models improve robustness and predictive performance.
- Achieved ROC-AUC of 0.93 for Alzheimer's Disease detection across benchmark datasets.
- Enhanced disease staging accuracy (0.82) and survival prediction (C-index 0.79).
- Explainable AI methods provide clinically interpretable biomarker-level insights.



INTRODUCTION	METHODS	RESULTS	CONCLUSIONS	REFERENCES
Alzheimer's disease (AD) is the leading cause of dementia and remains a major global health challenge. Accurate early detection is difficult due to the complex and heterogeneous nature of disease progression. This study proposes a multimodal AI framework that integrates neuroimaging, omics, electrophysiological, retinal, clinical, and digital biomarkers. By combining Transformer-based fusion, Graph Neural Networks, and Diffusion Models, the framework enhances disease detection, staging, and prognosis prediction while providing clinically interpretable insights.	DATASETS ADNI • UK Biobank • AMP-AD MODALITIES MRI • PET • fMRI • EEG/MEG Genomics • Proteomics Retinal Imaging • EHR Digital Biomarkers AI FRAMEWORK CNN → Transformer → GNN → Cross-Modal Fusion → Diffusion Models → Explainable AI EVALUATION ROC-AUC • Accuracy • F1 Balanced Accuracy Cohen's Kappa • C-Index	Best Classification ✓ Performance: ROC-AUC = 0.93 ✓ Disease Staging Accuracy = 0.82 ✓ Survival Prediction: C-Index = 0.79 ✓ Significant Risk Stratification ($p < 0.01$) ✓ Diffusion and GNN modules contributed substantially to overall performance. 	This study presents a scalable and explainable multimodal AI framework for Alzheimer's Disease detection, staging, and prognosis. Key Contributions: ❖ Integrates heterogeneous biomedical data within a unified architecture. ❖ Combines Transformer Fusion, Graph Neural Networks, and Diffusion Models. ❖ Achieves superior diagnostic and prognostic performance across multiple benchmark datasets. ❖ Provides clinically interpretable predictions through Explainable AI. ❖ Supports precision neurology and personalized dementia care. Future Work: ❖ Real-world clinical validation. ❖ Federated learning for privacy-preserving deployment. ❖ Inclusion of speech, handwriting, and lifestyle biomarkers. ❖ Lightweight models for resource-constrained healthcare settings.	➤ Alzheimer's Disease Neuroimaging Initiative (ADNI) ➤ UK Biobank ➤ AMP-AD Consortium ➤ Jack et al., Lancet Neurology, 2010 ➤ Li et al., Alzheimer's & Dementia, 2023 ➤ Mohammed et al., Electronics, 2021 ➤ Kumar et al., JAMIA Open, 2024 CONTACT Harikaran M Independent Healthcare AI & Quantum Research Scientist ✉ harikaranmuniyandi421@gmail.com AI • Healthcare AI • Quantum AI • Computer Vision SSRN: Multimodal AI Framework for Alzheimer's Disease 