



International Journal of Engineering Research and Science & Technology

www.ijerst.org

ISSN : 2319-5991



Vol. 22 No. 2 (2026)



ijerst.editor@gmail.com
editor@ijerst.com

Machine Learning Framework for Early Alzheimer's Identification Using Cognitive

Performance Measures

¹Mrs.B.Pallavi , ² Thota Akhila Rani, ³ Neha Madhuri Gottumukkala , ⁴ Lakshmi Alekhya Pulavarthi, ⁵Terlapu Venkata Surya Manikanta

¹ Assistant Professor, Department of Computer Science & Engineering (Artificial Intelligence & Data Science), ELURU COLLEGE OF ENGINEERING AND TECHNOLOGY:: ELURU.

¹ Email : bezawadapallavi@gmail.com

^{2,3,4,5} Students, Department of Computer Science & Engineering (Artificial Intelligence & Data Science),

ELURU COLLEGE OF ENGINEERING AND TECHNOLOGY:: ELURU

² akhilaranithota@gmail.com, ³ nehamadhurigottumukkala@gmail.com, ⁴ alekhyapulavarthi77@gmail.com, ⁵ suryamanikanta5256@gmail.com

ABSTRACT

Alzheimer's disease is a progressive neurodegenerative disorder that affects memory, cognitive abilities, and daily functioning. Early identification of Alzheimer's is crucial for timely intervention and improved patient care. This project presents a machine learning framework for the early detection of Alzheimer's disease using cognitive performance measures. The system collects patient data through structured cognitive assessments, including memory recall, language ability, attention span, and problem-solving skills. The collected data is preprocessed and analyzed to ensure consistency and accuracy. An ensemble machine learning model is employed to improve prediction performance by combining multiple algorithms, thereby increasing reliability and reducing error rates. The model evaluates the input cognitive scores and predicts whether a patient is likely to have Alzheimer's disease, along with a probability score indicating the confidence of the prediction. The framework is implemented using the Django web framework, providing a user-friendly interface for clinicians to input patient data, perform assessments, and view results. The system also maintains a database of patient records and prediction outcomes for future reference and analysis. Additionally, an integrated chatbot assists users by providing basic guidance related to Alzheimer's symptoms. The proposed system aims to support healthcare professionals by offering a fast, accurate, and efficient tool for early Alzheimer's detection. By leveraging machine learning techniques and cognitive performance data, this framework contributes to improved diagnostic processes and enhances decision-making in clinical environments.

Keywords: Alzheimer's Disease, Machine Learning, Early Detection, Cognitive Assessment, Ensemble Learning, Prediction System, Healthcare Analytics, Django Web Application, Clinical Decision Support, Chatbot Assistance.

I. INTRODUCTION

Alzheimer's disease is one of the most common neurodegenerative disorders, primarily affecting elderly individuals and leading to progressive decline in memory, thinking ability, and overall cognitive functioning. As the disease advances, it significantly impacts a person's ability to perform daily activities, placing a heavy emotional and financial burden on families and healthcare systems. Early detection of Alzheimer's is crucial, as it allows timely medical intervention, better disease management, and improved quality of life for patients. However, traditional diagnostic methods often rely on clinical observations and expensive medical imaging techniques, which may not always detect the disease at an early stage.

With the rapid advancement of technology, machine learning has emerged as a powerful tool in the healthcare domain for predicting and diagnosing diseases based on data patterns. This project focuses on developing a machine learning framework for the early identification of Alzheimer's disease using cognitive performance measures. The system utilizes structured cognitive assessments that evaluate memory, language, attention, and problem-solving abilities of individuals. These measures provide valuable insights into brain function and help in identifying early signs of cognitive impairment.

By applying an ensemble machine learning approach, the system improves prediction accuracy and reliability compared to traditional methods. The framework is implemented as a web-based application using Django, enabling clinicians to easily input patient data, perform assessments, and obtain prediction results with probability scores. Additionally, the system stores patient records for future reference and integrates supportive features such as a chatbot for basic guidance. Overall, this project aims to provide an efficient, cost-effective, and user-friendly solution to assist

healthcare professionals in the early detection of Alzheimer's disease.

II. LITERATURE SURVEY

1. Machine Learning Framework for Assessment of Cognitive and Functional Impairments in Alzheimer's Disease

Authors: N. Vinutha, S. Pattar, S. Sharma, P. D. Shenoy, K. R. Venugopal

Abstract:

This study presents a machine learning-based framework for assessing cognitive and functional impairments in Alzheimer's disease. The authors focus on neuropsychological scores and functional activity measures to evaluate patient conditions. One of the major challenges addressed is the presence of missing and imbalanced data in medical datasets. To overcome this, techniques such as MissForest imputation and Synthetic Minority Oversampling Technique (SMOTE) are applied. The framework uses machine learning algorithms to improve prediction accuracy and reliability. Experimental results demonstrate enhanced performance in identifying cognitive decline, making it useful for computer-aided diagnosis systems.

2. Machine Learning-Based Cognitive Assessment with Automated Evaluation

Authors: C. Howard et al.

Abstract:

This research focuses on validating an automated cognitive assessment system using machine learning techniques. The system is compared with traditional paper-based tests such as ACE-3 and MoCA. The study evaluates reliability across multiple cognitive domains including memory, attention, language, and visuospatial abilities. Results show high consistency and strong agreement with standard clinical assessments, demonstrating that machine learning-based cognitive evaluation can be an effective screening tool for neurological disorders, including Alzheimer's disease.

3. Alzheimer's Disease Diagnosis Using

Machine Learning: A Review

Authors: O. A. Dara et al.

Abstract:

This paper provides a comprehensive review of machine learning and artificial intelligence techniques used in Alzheimer's disease diagnosis. The study analyzes over 80 research works and highlights the importance of combining neuroimaging data and non-imaging biomarkers for improved prediction. The authors emphasize that machine learning models significantly enhance diagnostic accuracy and enable early detection. The review also discusses challenges such as data variability and the need for standardized approaches in clinical applications.

4. An Explainable Machine Learning Approach for Alzheimer's Disease Prediction

Authors: A. S. Alatrany et al.

Abstract:

This study explores the use of explainable machine learning models for predicting Alzheimer's disease. The authors highlight that early diagnosis is difficult due to subtle biomarker changes and complex data patterns. The proposed approach focuses not only on prediction accuracy but also on interpretability, allowing clinicians to understand model decisions. The study addresses challenges such as high-dimensional data and limited datasets, and demonstrates that explainable AI can improve trust and usability in clinical environments.

5. Assessment-Driven Machine Learning for Dementia Screening

Authors: C. Winalai

Abstract:

This research proposes a machine learning framework for dementia screening based entirely on cognitive assessments. The study highlights that traditional diagnostic methods relying on neuroimaging are expensive and not widely accessible. Cognitive assessments provide a scalable and cost-effective alternative, but their

interpretation can be complex. The proposed system applies machine learning techniques to analyze assessment data and improve diagnostic accuracy. The results indicate that assessment-driven models can effectively support early detection of dementia and Alzheimer's disease.

III. EXISTING SYSTEM

In the existing system, the diagnosis of Alzheimer's disease primarily relies on traditional clinical methods such as patient interviews, medical history analysis, neurological examinations, and cognitive tests conducted manually by healthcare professionals. In many cases, advanced diagnostic techniques like Magnetic Resonance Imaging (MRI), Computed Tomography (CT) scans, and laboratory tests are used to confirm the presence of the disease. These approaches depend heavily on the expertise of clinicians and are often time-consuming and costly. Additionally, early-stage symptoms of Alzheimer's are subtle and may be overlooked during routine examinations, making early detection difficult. The lack of automated tools for analyzing cognitive performance data further limits the efficiency and consistency of diagnosis.

IV. PROPOSED SYSTEM

The proposed system introduces a machine learning-based framework for the early identification of Alzheimer's disease using cognitive performance measures. The system collects patient data through structured cognitive assessments that evaluate memory, language, attention, and problem-solving abilities. These inputs are processed and fed into an ensemble machine learning model, which analyzes patterns in the data and predicts whether a patient is likely to have Alzheimer's disease.

The framework is implemented as a web-based application using the Django framework, providing an interactive and user-friendly interface for clinicians. Users can log in, conduct assessments, input patient responses, and instantly obtain

prediction results along with probability scores. The system also maintains a centralized database to store patient records and prediction history for future reference and analysis. Additionally, a chatbot feature is integrated to assist users with basic information and guidance related to Alzheimer’s symptoms. This automated approach ensures faster, more accurate, and consistent diagnosis, especially in the early stages of the disease.

V. SYSTEM ARCHITECTURE

The above system architecture illustrates a comprehensive pipeline for early detection of Alzheimer’s disease using machine learning techniques. It begins with data collection, where datasets such as ADNI data, cognitive scores, and information about Alzheimer’s-related drugs are gathered. This data then undergoes preprocessing, which includes steps like time filtering, handling missing values, drug code separation, data encoding, normalization, and time-series feature extraction to ensure clean and structured input for the model.

Next, in the data fusion and splitting stage, the processed data is divided into testing data and cross-validation data. To handle class imbalance, data balancing techniques are applied, improving model fairness and accuracy. The system then performs stratified 10-fold cross-validation, where the dataset is divided into training and validation sets to ensure robust model evaluation.

In the classification and optimization phase, multiple machine learning algorithms such as Support Vector Machine (SVM), Random Forest, Logistic Regression, Decision Tree, and K-Nearest Neighbor are trained and fine-tuned. These models learn patterns from cognitive data to identify potential Alzheimer’s cases. Finally, in the model evaluation stage, the trained models are tested using unseen data, and the results are analyzed to determine the best-performing model. This structured approach ensures accurate, reliable, and efficient

prediction of Alzheimer’s disease for early diagnosis.

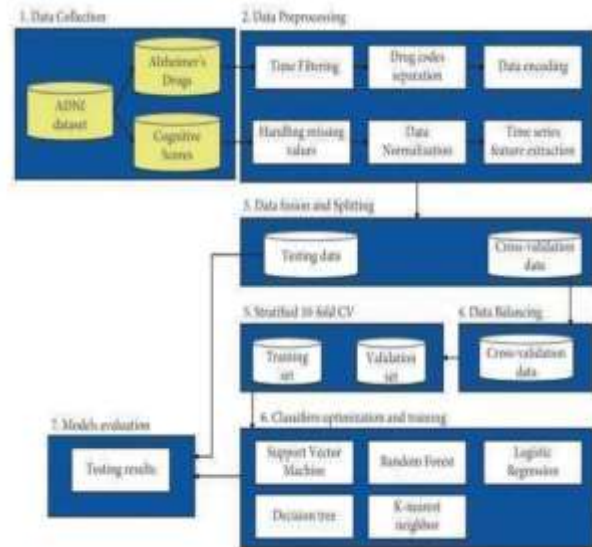


Fig 5.1: Structure of the Proposed System

VI. IMPLEMENTATION



Fig 6.1: Login Page

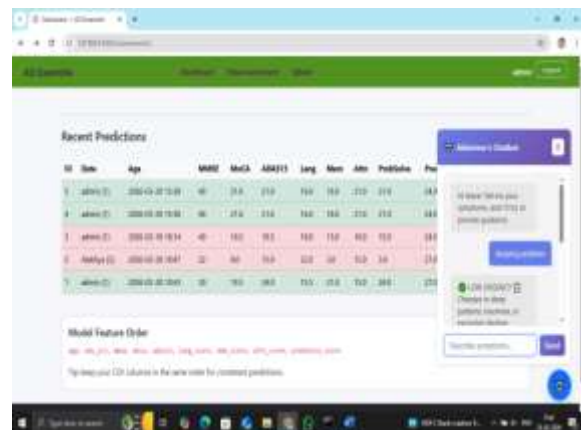


Fig 6.2: Chatbot Page

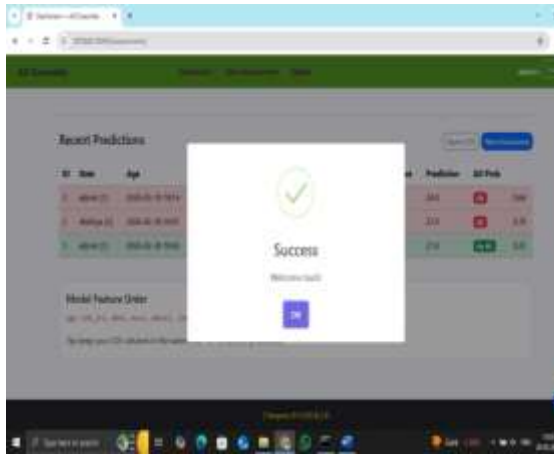


Fig 6.3: Success page

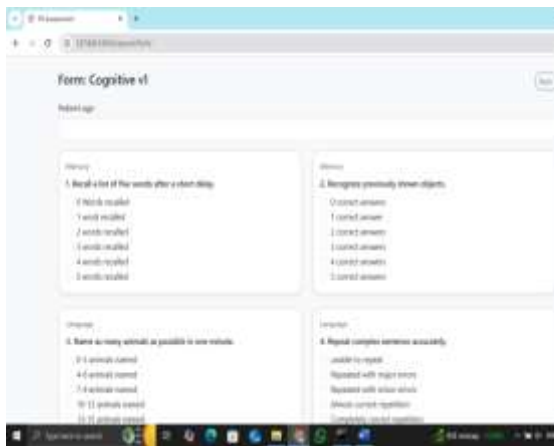


Fig 6.4: Assessment Page

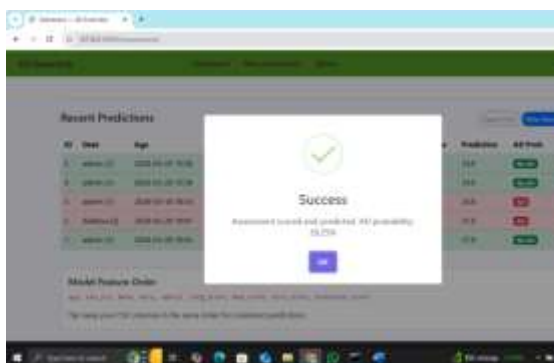


Fig 6.5:Results Image

VII. CONCLUSION

In conclusion, the proposed system successfully demonstrates the use of machine learning techniques for the early identification of Alzheimer’s disease using cognitive performance measures. By

analyzing key factors such as memory, language, attention, and problem-solving abilities, the system provides accurate predictions along with probability scores, helping clinicians make informed decisions. The integration of an ensemble learning approach improves prediction reliability and reduces errors compared to traditional methods. Additionally, the web-based implementation using Django ensures a user-friendly interface, efficient data management, and easy accessibility. The inclusion of features such as assessment forms, result storage, and chatbot support further enhances the usability of the system. Overall, this framework offers a cost-effective, fast, and reliable solution for early Alzheimer’s detection, contributing to better patient care and improved clinical outcomes.

VIII. FUTURE SCOPE

The proposed system can be further enhanced in several ways to improve its accuracy, usability, and real-world applicability. In the future, the model can be trained using larger and more diverse real-time clinical datasets to increase prediction reliability. Integration with advanced deep learning techniques and neuroimaging data such as MRI or CT scans can provide more comprehensive analysis for better diagnosis. The system can also be extended into a mobile or cloud-based application to enable remote access and real-time monitoring of patients. Additionally, incorporating multilingual support and voice-based cognitive assessments can make the system more accessible to a wider population. Further improvements may include personalized treatment recommendations, continuous patient tracking, and integration with hospital management systems. These enhancements will make the system more robust, scalable, and effective in

supporting early detection and management of Alzheimer's disease.

IX. REFERENCES

- [1] N. Koblitz, "Elliptic Curve Cryptosystems," *Mathematics of Computation*, vol. 48, no. 177, pp. 203–209, 1987.
- [2] A. Menezes, P. van Oorschot, and S. Vanstone, *Handbook of Applied Cryptography*. CRC Press, 1996.
- [3] D. Eastlake and P. Jones, "US Secure Hash Algorithm 1 (SHA1)," RFC 3174, 2001.
- [4] N. Vinutha, S. Pattar, S. Sharma, P. D. Shenoy, and K. R. Venugopal, "Machine Learning Framework for Assessment of Cognitive and Functional Impairments in Alzheimer's Disease," *Procedia Computer Science*, 2024.
- [5] C. Howard et al., "Machine Learning–Based Cognitive Assessment with Automated Evaluation," *Journal of Medical Systems*, 2023.
- [6] O. A. Dara et al., "Alzheimer's Disease Diagnosis Using Machine Learning: A Review," *Applied Sciences*, vol. 13, no. 14, 2023.
- [7] A. S. Alatrany et al., "An Explainable Machine Learning Approach for Alzheimer's Disease Prediction," *Scientific Reports*, 2024.
- [8] C. Winalai, "Assessment-Driven Machine Learning for Dementia Screening," *International Journal of Advanced Science and Information Systems*, 2022.
- [9] C. Kavitha et al., "Early-Stage Alzheimer's Disease Prediction Using Machine Learning," *Frontiers in Public Health*, 2022.