International Journal of Engineering Research and Science & Technology

www.ijerst.org

ISSN : 2319-5991

Vol. 22 No. 3 (2026)

ijerst.editor@gmail.com

editor@ijerst.com

International Journal of Engineering Research and Science & Technology
ISSN 2319-5991 www.ijerst.com

Peer Reviewed, Referred & Indexed Journal

Research Paper

Autism Spectrum Disorder Detection and Classification Using Machine Learning and Deep Learning Techniques

[1]G.Pinki
[1]Assistant Professor, Department Of computer science and engineering, Sreyas Institute of Engineering and Technology
[1]Email: bsp.pinki@gmail.com

ABSTRACT

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition that can affect communication, social interaction, behavior, and cognitive development. Early detection of ASD is important because timely intervention can significantly improve an individual's developmental and social outcomes. However, conventional diagnosis mainly depends on clinical observations, behavioral assessments, and expert evaluation, which can be time-consuming and subjective. This study proposes an intelligent approach for the detection and classification of Autism Spectrum Disorder using Machine Learning (ML) and Deep Learning (DL) techniques. The proposed system processes relevant clinical, behavioral, and demographic features to identify patterns associated with ASD. Various machine learning algorithms, such as Support Vector Machine, Random Forest, Decision Tree, Logistic Regression, and K-Nearest Neighbors, can be employed for comparative analysis, while deep learning models are used to automatically learn complex feature representations and improve classification performance. The models are evaluated using performance measures such as accuracy, precision, recall, F1-score, and confusion matrix. The proposed approach aims to provide an efficient, reliable, and automated method for ASD screening and classification, reducing dependence on manual assessment and supporting healthcare professionals in early decision-making. The integration of ML and DL techniques can enhance prediction accuracy and provide a scalable framework for computer-assisted ASD detection.

Keywords: Autism Spectrum Disorder (ASD), Autism Detection, Machine Learning, Deep Learning, Classification, Predictive Analysis, Feature Extraction, Healthcare, Artificial Intelligence, Early Diagnosis, Behavioral Analysis, Medical Data.

I.INTRODUCTION

Autism Spectrum Disorder (ASD) is a complex neurodevelopmental condition that affects an individual's social communication, interaction, behavior, and patterns of activities. The characteristics and severity of autism can vary considerably from one person to another, which makes its identification and classification a challenging task. Early detection of ASD is highly important because appropriate intervention and support at an early stage can help improve communication skills, learning abilities, social development, and overall quality of life. However, conventional ASD diagnosis generally depends on behavioral observations, clinical assessments, interviews, and evaluations performed by trained specialists. These approaches can require considerable time and expertise and may sometimes be influenced by subjective judgment.

The rapid development of Artificial Intelligence (AI) has created new opportunities for supporting the screening and classification of neurodevelopmental disorders. Machine Learning (ML) techniques can analyze large volumes of clinical and behavioral data and identify patterns that may not be easily recognized through conventional analysis. Algorithms such as Support Vector Machine (SVM),

Random Forest (RF), Decision Tree (DT), Logistic Regression (LR), and K-Nearest Neighbors (KNN) can be used to classify individuals based on selected features associated with ASD. These techniques can assist in identifying important relationships between input characteristics and diagnostic outcomes, thereby providing a faster and data-driven approach to preliminary screening.

Deep Learning (DL), a specialized branch of machine learning, further improves automated analysis by learning complex patterns and feature representations directly from data. Neural network architectures can process high-dimensional and nonlinear relationships that may be difficult for traditional machine learning algorithms to capture. Depending on the type of dataset, deep learning models can be designed to analyze behavioral, clinical, questionnaire-based, speech, image, or other relevant data for ASD detection. The combination of machine learning and deep learning therefore provides an opportunity to compare different computational approaches and determine which methods are more effective for accurate ASD classification.

The proposed work, "Autism Spectrum Disorder Detection and Classification Using Machine Learning and Deep Learning Techniques," focuses on developing an intelligent computational framework for identifying ASD-related patterns and classifying individuals into appropriate categories. The system involves data preprocessing, feature selection or extraction, model training, classification, and performance evaluation. Multiple ML and DL models can be trained and compared using evaluation metrics such as accuracy, precision, recall, F1-score, and confusion matrix. This comparative approach helps determine the strengths and limitations of different models and provides a more reliable understanding of their classification capabilities.

The proposed system is intended to function as a decision-support and screening tool rather than a replacement for professional clinical diagnosis. By automating the analysis of relevant data, the system can reduce the time required for preliminary screening and provide consistent results that may assist healthcare professionals, researchers, and caregivers. Overall, the integration of machine learning and deep learning techniques offers a promising approach for developing efficient, scalable, and data-driven ASD detection systems, with the potential to support earlier identification and improve access to timely intervention.

II.LITERATURE SURVEY

1. Hyde et al. (2019) – Supervised Machine Learning for ASD Research

Authors: Kayleigh K. Hyde, Marlena N. Novack, Nicholas LaHaye, Chelsea Parlett-Pelleriti, Raymond Anden, Erik Linstead, Dennis R. Dixon

Year: 2019

Title: Applications of Supervised Machine Learning in Autism Spectrum Disorder Research: A Review

Abstract:

Hyde et al. presented a comprehensive review of supervised machine learning applications in Autism Spectrum Disorder research. The study analyzed 45 research papers and examined different machine learning techniques used for ASD classification, diagnosis, genetic analysis, and intervention-related applications. Support Vector Machine, decision-tree methods, LASSO, Random Forest, neural networks, logistic regression, and deep learning were among the frequently used techniques. The authors concluded that machine learning has considerable potential for identifying meaningful patterns in ASD-related datasets, although limitations related to dataset size, clinical validation, and methodological consistency remain.

2. Song et al. (2019) – Artificial Intelligence in ASD Screening

Authors: Da-Yeon Song, So Yoon Kim, Guiyoung Bong, Jong Myeong Kim, Hee Jeong Yoo
Year: 2019
Title: The Use of Artificial Intelligence in Screening and Diagnosis of Autism Spectrum Disorder: A Literature Review
Abstract:
Song et al. reviewed the use of artificial intelligence techniques for ASD screening and diagnosis. The study investigated how machine learning and other AI-based approaches can analyze behavioral, clinical, genetic, and neuroimaging information associated with autism. The review highlighted the ability of AI systems to support objective and automated assessment while also identifying challenges involving data quality, interpretability, sample size, and clinical applicability. The authors suggested that AI could become a useful supporting technology for ASD screening when appropriately validated.

3. Thabtah (2020) – Machine Learning-Based ASD Detection
Author: Fadi Thabtah
Year: 2020
Title: Analysis and Detection of Autism Spectrum Disorder Using Machine Learning Techniques
Abstract:
Thabtah investigated several machine learning and deep learning algorithms for detecting ASD using publicly available screening datasets for children, adolescents, and adults. The study evaluated Naïve Bayes, Support Vector Machine, Logistic Regression, K-Nearest Neighbors, Artificial Neural Network, and Convolutional Neural Network models. The results demonstrated that CNN-based approaches achieved strong classification performance across the evaluated datasets. The research demonstrated that automated learning models can effectively analyze questionnaire-based ASD screening data and support the development of computer-assisted ASD detection systems.

4. Eslami et al. (2021) – ML and DL Using MRI Data
Authors: Taban Eslami, Fahad Almuqhim, Joseph S. Raiker, Fahad Saeed
Year: 2021
Title: Machine Learning Methods for Diagnosing Autism Spectrum Disorder and Attention-Deficit/Hyperactivity Disorder Using Functional and Structural MRI: A Survey
Abstract:
Eslami et al. reviewed machine learning and deep learning approaches used for ASD and ADHD diagnosis using functional and structural MRI data. The study examined conventional machine learning techniques as well as emerging deep learning methods for extracting patterns from neuroimaging data. The authors discussed important issues such as feature extraction, dataset limitations, model evaluation, and methodological pitfalls. The review indicated that neuroimaging combined with machine learning provides promising opportunities for automated ASD identification, although larger and more standardized datasets are required for reliable clinical application.

5. Rahman et al. (2020) – Feature Selection and Classification
Authors: Md. Mokhlesur Rahman, Opeyemi Lateef Usman, Ravie Chandren Muniyandi, Shahnorbanun Sahran, Suziyani Mohamed, Rogayah A. Razak
Year: 2020
Title: A Review of Machine Learning Methods of Feature Selection and Classification for Autism Spectrum Disorder
Abstract:
Rahman et al. investigated machine learning methods used for feature selection and classification in ASD research. The study emphasized that selecting relevant features is important because ASD datasets may contain numerous behavioral, clinical, and demographic attributes. Different feature-selection and classification strategies were

reviewed to understand their influence on prediction performance. The authors reported that appropriate feature selection can improve classification efficiency, reduce unnecessary information, and potentially enhance model interpretability.

6. Francese and Yang (2021/2022) – Machine Learning and Wearable Sensors

Authors: Rita Francese, Xiaomin Yang

Year: 2021/2022

Title: Supporting Autism Spectrum Disorder Screening and Intervention with Machine Learning and Wearables: A Systematic Literature Review

Abstract:

Francese and Yang conducted a systematic literature review of machine learning techniques combined with wearable sensors for ASD detection and intervention. The study examined research published between 2015 and February 2021 and analyzed the types of wearable devices, machine learning algorithms, ASD-related activities, and evaluation methods used in previous studies. The review indicated that wearable technologies can provide continuous behavioral and physiological information that may complement conventional ASD assessment. However, the authors also identified challenges involving data collection, privacy, reliability, and standardized evaluation.

7. Parlett-Pelleriti et al. (2022) – Unsupervised Machine Learning

Authors: Chelsea M. Parlett-Pelleriti, Elizabeth Stevens, Dennis Dixon, Erik J. Linstead

Year: 2022

Title: Applications of Unsupervised Machine Learning in Autism Spectrum Disorder Research: A Review

Abstract:

Parlett-Pelleriti et al. reviewed the application of unsupervised machine learning techniques in ASD research. Unlike supervised learning, unsupervised methods attempt to discover hidden patterns and natural groupings within datasets without relying completely on predefined diagnostic labels. The study highlighted clustering and other unsupervised approaches as useful tools for understanding heterogeneity within the autism spectrum. Such methods can potentially reveal subgroups and behavioral patterns that may not be apparent through conventional classification techniques.

8. Unsupervised ASD Screening Study (2022)

Year: 2022

Title: Autism Screening: An Unsupervised Machine Learning Approach

Abstract:

This study proposed an unsupervised machine learning framework for reducing classification bias in ASD screening. A Self-Organizing Map was initially used to identify patterns and refine class labels, followed by classification algorithms applied to the refined dataset. The approach was evaluated using a dataset containing more than 2,000 instances obtained from ASD screening systems. The study demonstrated that combining unsupervised pattern discovery with subsequent classification could provide an alternative approach to conventional ASD screening and potentially address some limitations associated with predefined labels.

III.EXISTING SYSTEM

The existing systems for Autism Spectrum Disorder (ASD) detection primarily depend on clinical evaluation, behavioral observation, interviews, questionnaires, and standardized screening procedures conducted by trained healthcare professionals. These approaches assess communication skills, social interaction, repetitive behaviors, and developmental characteristics to identify possible signs of ASD. In recent years, machine learning techniques such as Support Vector Machine, Random Forest, Decision Tree, Logistic Regression, and K-Nearest Neighbors have also been applied to questionnaire-based and clinical datasets for automated ASD classification. Deep learning methods,

including Artificial Neural Networks and Convolutional Neural Networks, have further been explored for analyzing complex behavioral and neuroimaging data. Although these systems can improve the speed and consistency of preliminary screening, existing approaches often face limitations such as small and imbalanced datasets, dependence on selected features, high computational requirements for certain data types, limited interpretability, and insufficient clinical validation. Therefore, there is a need for a more efficient and reliable system that combines machine learning and deep learning techniques for improved ASD detection and classification.

IV.PROPOSED SYSTEM

The proposed system focuses on developing an intelligent and automated framework for Autism Spectrum Disorder (ASD) detection and classification using Machine Learning and Deep Learning techniques. The system takes relevant clinical, behavioral, demographic, or questionnaire-based data as input and performs preprocessing operations such as data cleaning, handling missing values, encoding categorical features, normalization, and feature selection. After preprocessing, multiple machine learning algorithms such as Support Vector Machine, Random Forest, Decision Tree, Logistic Regression, and K-Nearest Neighbors are trained to identify ASD-related patterns and classify the input data. In addition, deep learning techniques such as Artificial Neural Networks and Convolutional Neural Networks can be implemented to learn complex relationships and improve classification capability. The performance of the developed models is compared using accuracy, precision, recall, F1-score, and confusion matrix. The best-performing model is selected for the final prediction and provides an automated indication of whether the input is likely to belong to the ASD or non-ASD category. The proposed system aims to provide a fast, consistent, and data-driven screening approach that can assist healthcare professionals in preliminary ASD assessment while not replacing professional clinical diagnosis.

V.SYSTEM ARCHITECTURE

The proposed system architecture for Autism Spectrum Disorder Detection and Classification Using Machine Learning and Deep Learning Techniques consists of several sequential stages, beginning with data collection and ending with ASD prediction. The architecture is designed to process relevant patient information, prepare the data, train different machine learning and deep learning models, evaluate their performance, and use the best-performing model for final classification.

The Data Collection stage is the first component of the system. It collects the information required for ASD detection from sources such as questionnaire data, demographic information, behavioral characteristics, and publicly available ASD datasets. These inputs may contain details related to communication, social behavior, developmental characteristics, and other relevant attributes. The collected information forms the basic dataset required for training and testing the prediction models.

The next stage is Data Preprocessing, where the collected data is prepared for machine learning and deep learning algorithms. Data cleaning is performed to remove incorrect or unnecessary records, while missing values are handled appropriately. Categorical features are converted into numerical representations through encoding, and normalization is applied to bring numerical features into a suitable range. Feature selection or feature extraction is then performed to identify the most useful attributes for ASD classification. This stage helps improve data quality and can reduce unnecessary computational complexity.

After preprocessing, the dataset is divided into Training and Testing Sets. In the architecture, 80% of the data is used for training and 20% for testing. The training

set is used to teach the models to recognize patterns associated with ASD, while the testing set is used to determine how well the trained models perform on previously unseen data. Separating the data in this way helps provide a more reliable evaluation of the prediction system.

The Model Training stage consists of two major categories: Machine Learning and Deep Learning. The machine learning section includes Support Vector Machine (SVM), Random Forest (RF), Decision Tree (DT), Logistic Regression (LR), and K-Nearest Neighbors (KNN). These algorithms analyze the processed features and learn patterns that can distinguish ASD from non-ASD cases. The deep learning section includes Artificial Neural Network (ANN) and Convolutional Neural Network (CNN) models, which can learn more complex relationships and representations from the input data.

Following model training, the different models undergo Model Evaluation. Their performance is assessed using metrics such as accuracy, precision, recall, F1-score, and confusion matrix. These measures help determine how accurately each model identifies ASD cases and non-ASD cases. Comparing these metrics allows the system to identify the model that provides the most suitable classification performance.

The Best Performing Model is then selected based on the evaluation results. This model can be either a machine learning or deep learning model, depending on which achieves the best overall performance. The selected trained model is subsequently used for making predictions on new patient data. This ensures that the final prediction is generated using the model that demonstrated the strongest performance during evaluation.

In the Prediction/Classification stage, new patient information is provided as input to the selected trained model. The model analyzes the input features and produces a classification result, mainly ASD or Non-ASD. The prediction provides an automated preliminary indication based on the patterns learned from the training data.

Finally, the Application stage represents the practical use of the system. The developed framework can assist healthcare professionals and researchers in early ASD screening and decision support by providing fast and consistent computational predictions. However, the system is intended to support preliminary screening and should not be considered a replacement for professional clinical diagnosis.

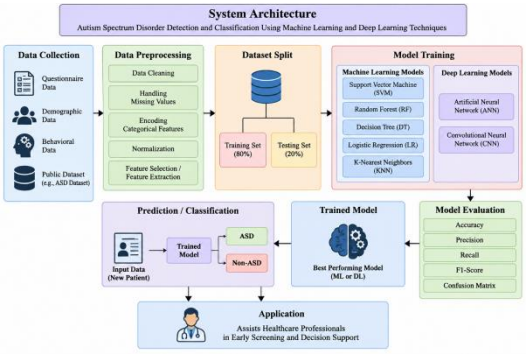

Fig 5.1 System Architecture

VI.IMPLEMENTATION

Fig 6.1 Home Page

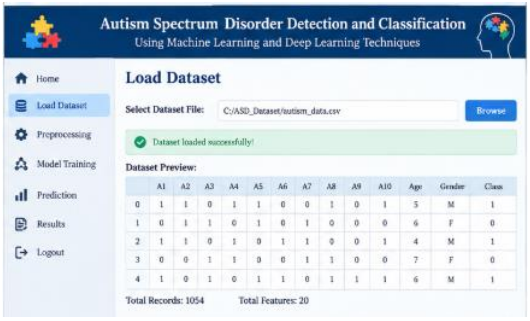

Fig 6.2 Dataset Upload

Fig 6.3 Model Training

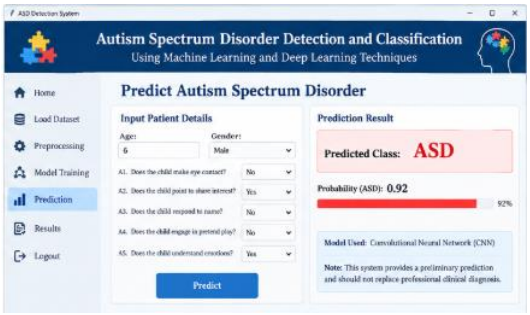

Fig 6.4 Prediction Result

VII.CONCLUSION

The proposed Autism Spectrum Disorder Detection and Classification Using Machine Learning and Deep Learning Techniques provides an intelligent and automated approach for supporting the early screening of ASD. The system processes relevant questionnaire, demographic, and behavioral information through different preprocessing techniques, including data cleaning, missing-value handling, categorical encoding, normalization, and feature selection. This ensures that the input data is properly prepared for effective model training and classification.

The system applies multiple machine learning algorithms, including SVM, Random Forest, Decision Tree, Logistic Regression, and KNN, along with deep learning models such as ANN and CNN. Their performance can be compared using accuracy, precision, recall, F1-score, and confusion matrix to identify the most suitable model. The selected model can then classify new input data into ASD or Non-ASD, providing a fast and consistent preliminary prediction.

Overall, the integration of machine learning and deep learning offers a promising solution for reducing the time and effort involved in preliminary ASD screening. The proposed system can serve as a useful decision-support tool for healthcare professionals and researchers, while the final diagnosis should continue to be performed by qualified clinical professionals. Future improvements can include larger and more diverse datasets, advanced deep learning architectures, explainable AI techniques, real-time screening, and integration of additional behavioral, speech, or neuroimaging data to further improve the reliability and applicability of the system.

VIII.FUTURE SCOPE

The future scope of the proposed Autism Spectrum Disorder Detection and Classification Using Machine Learning and Deep Learning Techniques is broad, with several opportunities to improve the accuracy, reliability, and practical usability of the system. Future work can focus on collecting larger and more diverse datasets from different age groups, geographical regions, and demographic backgrounds. This can help reduce dataset bias and improve the generalization capability of the trained models. Additional behavioral, clinical, speech, and developmental features can also be incorporated to provide a more comprehensive assessment.

Advanced deep learning architectures, such as transfer learning, recurrent neural networks, and transformer-based models, can be explored to identify complex patterns that conventional models may not capture effectively. Explainable AI techniques can also be integrated so that the system can provide understandable reasons behind its predictions, making the results more useful for healthcare professionals. Furthermore, the system could be extended to analyze speech, facial expressions, video-based behavior, and neuroimaging data in addition to questionnaire-based information.

In the future, the proposed system can be developed as a web-based or mobile application that enables convenient

preliminary ASD screening. Real-time prediction, secure cloud-based processing, and integration with electronic healthcare systems could make the solution more accessible and scalable. Continuous model improvement using newly collected and properly validated data can further enhance performance. With extensive clinical validation and appropriate privacy and security measures, the system could become a valuable decision-support tool for early ASD screening and personalized intervention planning, while continuing to complement rather than replace professional clinical diagnosis.

IX.REFERENCES

[1] K. K. Hyde, M. N. Novack, N. LaHaye, C. Parlett-Pelleriti, R. Anden, D. R. Dixon, and E. Linstead, "Applications of Supervised Machine Learning in Autism Spectrum Disorder Research: A Review," Review Journal of Autism and Developmental Disorders, vol. 6, pp. 128–146, 2019. DOI: 10.1007/s40489-019-00158-x.

[2] D. Y. Song, S. Y. Kim, G. Bong, J. M. Kim, and H. J. Yoo, "The Use of Artificial Intelligence in Screening and Diagnosis of Autism Spectrum Disorder: A Literature Review," Journal of the Korean Academy of Child and Adolescent Psychiatry, vol. 30, no. 4, pp. 145–152, 2019. DOI: 10.5765/jkacap.190027.

[3] F. Thabtah, N. Abdelhamid, and D. Peebles, "A Machine Learning Autism Classification Based on Logistic Regression Analysis," Health Information Science and Systems, vol. 7, no. 1, 2019. DOI: 10.1007/s13755-019-0073-5.

[4] E. Stevens, D. R. Dixon, M. N. Novack, D. Granpeesheh, T. Smith, and E. Linstead, "Identification and Analysis of Behavioral Phenotypes in Autism Spectrum Disorder via Unsupervised Machine Learning," International Journal of Medical Informatics, vol. 129, pp. 29–36, 2019. DOI: 10.1016/j.ijmedinf.2019.05.006.

[5] M. N. Parikh, H. Li, and L. He, "Enhancing Diagnosis of Autism With Optimized Machine Learning Models and Personal Characteristic Data," Frontiers in Computational Neuroscience, vol. 13, 2019. DOI: 10.3389/fncom.2019.00009.

[6] M. M. Rahman, O. L. Usman, R. C. Muniyandi, S. Sahran, S. Mohamed, and R. A. Razak, "A Review of Machine Learning Methods of Feature Selection and Classification for Autism Spectrum Disorder," Brain Sciences, vol. 10, no. 12, 949, 2020. DOI: 10.3390/brainsci10120949.

[7] T. Eslami, F. Almuqhim, J. S. Raiker, and F. Saeed, "Machine Learning Methods for Diagnosing Autism Spectrum Disorder and Attention-Deficit/Hyperactivity Disorder Using Functional and Structural MRI: A Survey," Frontiers in Neuroinformatics, vol. 14, 575999, 2021. DOI: 10.3389/fninf.2020.575999.

[8] R. Francese and X. Yang, "Supporting Autism Spectrum Disorder Screening and Intervention with Machine Learning and Wearables: A Systematic Literature Review," Complex & Intelligent Systems, vol. 8, pp. 3659–3674, 2022. DOI: 10.1007/s40747-021-00447-1.

[9] C. M. Parlett-Pelleriti, E. Stevens, D. Dixon, and E. J. Linstead, "Applications of Unsupervised Machine Learning in Autism Spectrum Disorder Research: A Review," Review Journal of Autism and Developmental Disorders, vol. 10, pp. 406–421, 2023. DOI: 10.1007/s40489-021-00299-y.

[10] M. Liu, B. Li, and D. Hu, "Autism Spectrum Disorder Studies Using fMRI Data and Machine Learning: A Review," Frontiers in Neuroscience, vol. 15, 697870, 2021. DOI: 10.3389/fnins.2021.697870.

[11] M. S. Ahammed, S. Niu, M. R. Ahmed, J. Dong, X. Gao, and Y. Chen, "DarkASDNet: Classification of ASD on Functional MRI Using Deep Neural Network," Frontiers in Neuroinformatics, vol. 15, 635657, 2021. DOI: 10.3389/fninf.2021.635657.

[12] J. Gao, M. Chen, Y. Li, Y. Gao, Y. Li, S. Cai, and J. Wang, "Multisite Autism Spectrum Disorder Classification Using Convolutional Neural Network Classifier and Individual Morphological Brain Networks," Frontiers in Neuroscience, vol. 14, 629630, 2021. DOI: 10.3389/fnins.2020.629630.

[13] C. J. Mellema, K. P. Nguyen, A. Treacher, and A. Montillo, "Reproducible Neuroimaging Features for Diagnosis of Autism Spectrum Disorder with Machine Learning," Scientific Reports, vol. 12, 3057, 2022. DOI: 10.1038/s41598-022-06459-2.

[14] M. P. V. Milner, C. Babu, S. Jose, S. Adhikari, L. S. K. Singh, J. Francis, and A. V. Parekkattil, "Autism Spectrum Disorder Identification Using Machine Learning Models on MRI Data," Scientific Reports, vol. 16, 24650, 2026. DOI: 10.1038/s41598-026-55163-y.

[15] M. A. Anwar, M. T. Islam, and T. Alam, "Machine Learning Model for the Detection of Autism Spectrum Disorder Using Electroretinogram Signals," Scientific Reports, 2026. DOI: 10.1038/s41598-026-59539-y.