International Research Journal on Advanced Engineering Hub (IRJAEH)
e ISSN: 2584-2137
Vol. 03 Issue: 06 June 2025
Page No: 2862-2868
https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2025.0422

Detection of Autism Spectrum Disorder

Charita Ganipineni [1], Dr. U Chaitanya[2], Jhade Sharanya[3]
[1,3]UG Scholar, Dept. of CSB, Mahatma Gandhi Institute of Technology, Hyderabad, Telangana, India.
[2]Assistant professor, Dept. of IT, Mahatma Gandhi Institute of Technology, Hyderabad, Telangana, India.
Email ID: *charitaganipineni@gmail.com[1], uchaitanya_it@mgit.ac.in[2], jhadesharanya@gmail.com[3]*

Abstract

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder with complex characteristics of social interaction, communication, and behavior difficulties. Early identification of ASD is important for early intervention and successful treatment. The purpose of this project is to create a multimodal system for early detection and classification of ASD using both textual information from behavioral screening questionnaires and visual information from facial images. The system makes use of a machine learning-driven decision tree model for analyzing text responses and a deep learning-driven Convolutional Neural Network (CNN) for processing facial images. The output from both models is fused by employing fuzzy logic in order to come up with a final ASD risk classification. Integration of both text and image information allows the system to present an improved, overall assessment of the likelihood of a person having ASD. Using sophisticated data processing methods, such as feature extraction, normalization, and time frame creation, the system guarantees resilience and flexibility across different applications. This strategy provides an all-inclusive solution to early detection, of ASD, assisting medical specialists in making appropriate choices and enabling prompt intervention to improve outcomes.

Keywords: *Autism Spectrum Disorder, Machine Learning, Image Analysis Behavioral Patterns, Facial Expressions, Diagnosis Efficiency.*

1. Introduction

Autism Spectrum Disorder is a neuro developmental disorder which significantly impacts an individual's social interaction, effective communication, and adaptation to changing circumstances. According to the estimation of the World Health Organization (WHO), around 1 of 100 children worldwide suffer from ASD. ASD is considered to be a" spectrum" because of the wide range in symptoms and severity across patients. While some individuals may present with mild symptoms and can function relatively independently, others may require substantial support in daily living activities. Early diagnosis of ASD is critical because timely interventions can significantly improve cognitive, social, and behavioral outcomes. However, diagnosing ASDis is not an easy task. It involves multi-faceted assessments, including clinical observations, behavioral analysis, and standardized diagnostic tools such as the Autism Diagnostic Observation Schedule (ADOS) and the Modified Checklist for Autism in Toddlers (M-CHAT)

1.1.Detection Using Normal Datasets

In the early days of ASD research, detection methods were based on normal datasets. These are structured collections of textual and diagnostic information that do not contain images or video data. These datasets form the basis of understanding ASD through quantitative behavioral metrics and clinical observations. Some of the key components of these datasets include: Behavioral and Diagnostic Records: The ADOS and MCHAT are standardized tools that provide intensive details regarding the child's behavior, including response to social cues, motor coordination, and repetition. These provided structured output in the forms of symptom severity scores, for instance, which can easily be computed and analyzed with a combination of statistical and machine learning models

International Research Journal on Advanced Engineering Hub (IRJAEH)
e ISSN: 2584-2137
Vol. 03 Issue: 06 June 2025
Page No: 2862-2868
https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2025.0422

2. Problem Statement

This project aims to revolutionize autism spectrum disorder diagnosis using Machine Learning techniques. Traditional methods, though accurate, are costly, time-consuming, and subjective, delaying early intervention. With ASD affecting 1 in 44 children globally, a swift, accessible, and affordable diagnostic tool is crucial. The proposed solution leverages ML to analyze behavioral patterns, facial expressions, and gestures from images and videos, enabling faster, more accurate, and scalable diagnosis. This approach enhances early detection, improving treatment outcomes and quality of life for individuals with ASD and their families.

3. Literature Survey

Recent advances in artificial intelligence and behavioral data analysis have resulted in hopeful advances in the early detection of ASD. Akter et al. [1] introduced a facial recognition system with an extended mobile set V1 architecture that had a classification accuracy of 90.67% when using a collection of 2,936 facial images. In this model, we employed K-Means clustering to determine ASD types with an accuracy of 92.10% using K=2 cluster size. As much as the results were promising, the model had a limitation due to the reliance on good-quality views of faces and a reduction in performance in classifying more subtypes. Mahamoo et al. [4] presented a deep learning model with high accuracy, utilizing both local and global facial features. Nonetheless, with only facial images and small datasets raising issues about the generalizability and resilience of the model in diverse realworld scenarios. Apart from examining faces, we also examined the behavioral measures of base behavior. Wang et al. [2] introduced the response (RTN) procedure to 16-month-old children. This has been translated into using perspectives in measuring social engagement. The research attained 95% reliability based on clinical ASD diagnosis in a small sample population of 20 individuals. Optimistically, sample sizes were minimal, and information regarding gaze estimation technology was not disclosed fully, restricting reproducibility and generalizability of findings. Hasan et al. [3] took the direction of applying a more complete style and cumulative behavior information like face expression, eye gauze, and voice to machine learning algorithms like support vector machines and random forests. A high rate of classification accuracy was shown with a data set of 150 children but with no practical value of the frame considering that there is little data record size and no validation provided. [5]. However, the absence of audio analysis in such an approach disqualified valuable references. [6] Multimodal deep learning solution authored by imaging data on diagnostics' robustness of integrated neurons, behavior and imaging data, but incorporating costly and tedious data acquisition deployed in the problem at large or low resource low settings. Other research targets ambitions with behavioral control machine learning from computer-assisted image-based detection [7], thermal eye closure-based [8], and structured data sets [9]. Finally, [10] applied a symmetric uncertainty selection method founded on symmetric uncertainty to classify ASD. This enhanced interpretability and accuracy of results with machine learning but suggested investigating more advanced classification models like deep learning to enhance other performances. However, the majority of them are still disadvantaged by limited data records, single-modality dependence, or low generalizability. Future efforts should aim at fusing different data records, multi-sources, and real-world evaluations to design scalable, accurate and feasible ASD diagnostic systems.

4. Architecture of ASD

Figure 1 illustrates the architecture of autism spectrum disorder system using Machine learning. It comprises of several levels: User Interface, Machine Learning Module, Deep Learning Module, Fuzzy Logic Integration Module.

4.1. User Interface Module

The User Interface Module is the user interface of the ASD detection system, made user-friendly for parents, guardians, and healthcare providers. It contains first-time screens of Home, Register, and Login, enabling users to register or log in securely. Once logged in, users can load images for analysis by deep learning or fill behavioral questionnaires to make predictions via machine learning. The inputs get processed and invoke the prediction flow. After

International Research Journal on Advanced Engineering Hub (IRJAEH)
e ISSN: 2584-2137
Vol. 03 Issue: 06 June 2025
Page No: 2862-2868
https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2025.0422

rendering the results, users can securely log out so that privacy can be ensured. The interface remains intuitive and is accessible even by non-technical users. (Figure 1)

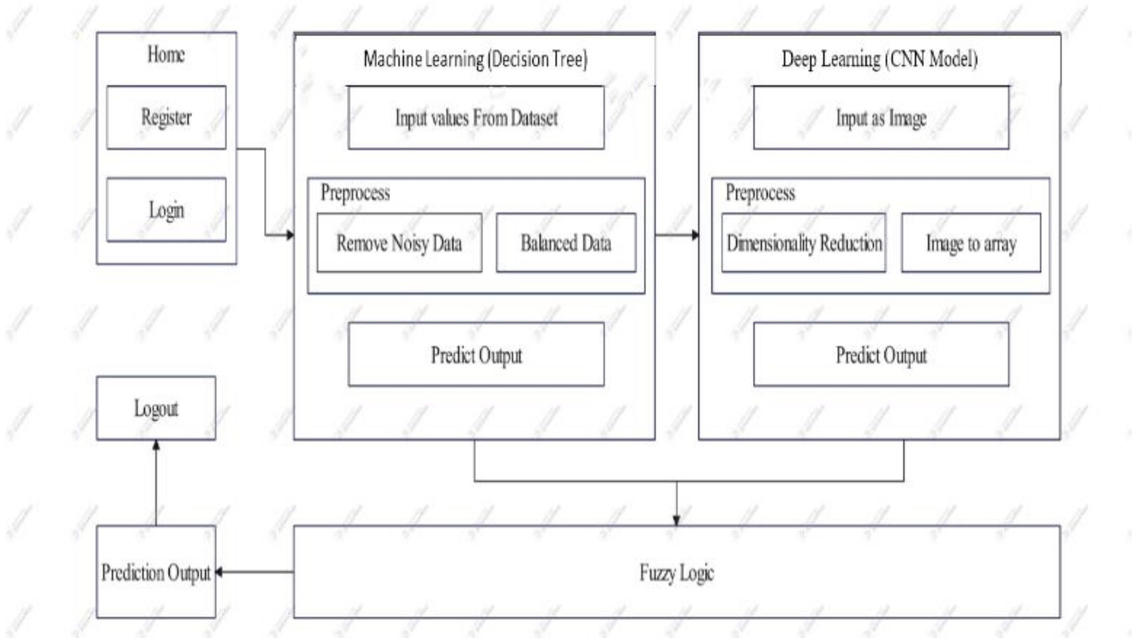

Figure 1 Architecture for Autism Spectrum Disorder System

4.2.Machine Learning Module

The Machine Learning Module within this project processes structured behavioral information to carry out ASD prediction. It collects inputs like questionnaire forms and numerical behavior features, constituting a structured dataset prepared for analysis. Prior to moving to prediction, the system undertakes critical preprocessing steps. Noise Removal is utilized to remove missing, inconsistent, or erroneous values from the dataset. The Data Balancing algorithms are then applied to address class imbalances and provide equitable and precise classification results. Following preprocessing, the system applies the Decision Tree algorithm solely for prediction. The Decision Tree model processes the clean and balanced input features, learns significant patterns, and produces an initial prediction of the probability of ASD in the subject.

4.3.Deep Learning Module

The Deep Learning Module applies deep learning methods to examine facial images and identify patterns for autism spectrum disorder. It begins with a labeled dataset, where images are labeled to show whether the person has ASD, providing the foundation for model training. In preprocessing, dimensionality reduction minimizes image size without losing significant features, and image-to-array conversion converts the images into numerical arrays for input to deep learning. A Convolutional Neural Network (CNN) is then utilized to learn important features, including face orientation and facial expressions, so as to accurately predict ASD.

4.4.Fuzzy Logic Integration Module

The module integrates ML and DL pipelines predictions to provide a better diagnosis. The module starts by performing input fusion, where results from both models are fused together. Uncertainty management is realized through fuzzy logic rules that handle variability and enhance prediction reliability. The ultimate decision is then realized, providing a stable diagnosis together with a confidence score.

International Research Journal on Advanced Engineering Hub (IRJAEH)
e ISSN: 2584-2137
Vol. 03 Issue: 06 June 2025
Page No: 2862-2868
https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2025.0422

Through fuzzy logic, the system effectively fuses both sources of data, maximizing reliability in uncertain scenarios. The hybrid technique is non-intrusive, scalable, and well-suited for early ASD detection, suitable for both clinical and remote use.

5. Results

The process starts with user screening, where the user enters simple demographic information, responds to a set of autism-related behavioral questions, and compulsorily uploads a facial photo. The behavioral inputs are analyzed via a trained Decision Tree model to compute prediction probability, whereas the uploaded photo is processed via a Convolutional Neural Network (CNN) model to detect ASD-related facial features. The results from each model are then combined by a Fuzzy Logic Controller, merging probability and image severity into a final diagnostic choice. A manual Risk Score is also determined based on responses to behavioral questionnaires. The dual-modality system provides a comprehensive and resilient evaluation of likelihood of ASD based on both behavioral and visual information. The system has been tested effectively for accuracy, consistency, and usability and thus stands as a very reliable system for early detection of ASD. (Figure 2)

Figure 2 Register Page

Figure 2 is a friendly registration form created to promote engagement and facilitate awareness of autism spectrum disorder (ASD). The form enables users to quickly create an account by entering their username, email, password, phone number, and address. A bottom Register button submits the form, while another link allows access for already registered users so that they can log in. This feature guarantees smooth access to both new and repeat users, promoting more interaction and participation with the resources on the platform. (Figure 3)

Figure 3 Login Page

Figure 4 presents a straightforward and user-friendly login form for existing users. The form requests the input of users' Username and Password to login to their accounts. A Submit button enables submission, and a link is presented below for non-account users with an easy way to the registration page. The login feature provides effortless user entry to the resources on the platform and encourages prolonged usage of the content.

Figure 4 Autism Screening Questionnaire and Image Upload for Predicting

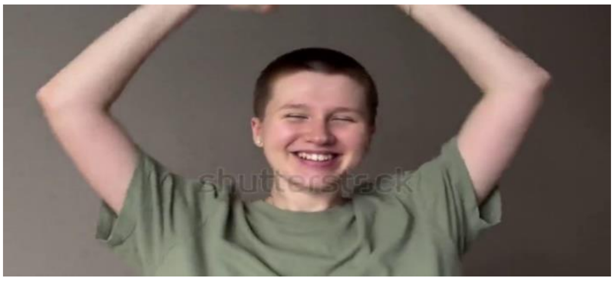

Figure 5 Autism Image Uploaded

International Research Journal on Advanced Engineering Hub (IRJAEH)
e ISSN: 2584-2137
Vol. 03 Issue: 06 June 2025
Page No: 2862-2868
https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2025.0422

Figure 5 shows the Autism Detection System interface where users input responses to screening questions (using a scale of 0 or 1) and Fig 4.4 is uploaded as image. The system then processes the data from both the text responses and the uploaded image to detect potential signs of autism spectrum disorder. The interface allows for seamless user experience in diagnosing ASD based on both behavioral and visual data.

Figure 6 Autism is Detected

Fig 6 shows the results of the Autism Prediction System. The user receives an Autism Detected diagnosis, with an Autism Risk Score of 0.8 based on form answers and a Model Prediction Probability of 0.8. The Image Prediction indicates Adult ASD, and the Final Decision based on fuzzy logic confirms Autism Detected with a final score of 0.75. The result is based on both behavioural (form) and visual (image) data, showcasing the system's combined prediction methodology.

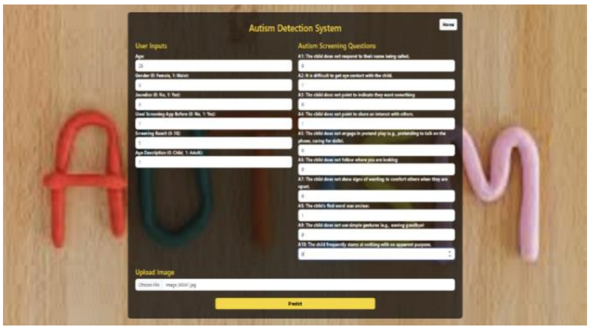

Figure 7 Input Values without Autism

Fig 7 Autism Detection System user interface. It contains multiple sections where the user can input details such as age, gender, screening results, and various autism-related behavioral questions. The input form is designed to assess various behavioral traits that are commonly associated with autism spectrum disorder. Fig 6.7 is an image uploaded for analysis. Once the user fills in the required fields and uploads an image, they can click the "Predict" button to initiate the ASD detection process, which will analyses both the form data and image data to generate a diagnosis.

Figure 7 Healthy Adult

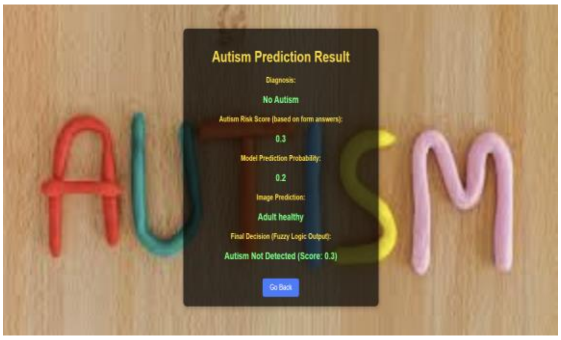

Figure 8 Autism Not Detected

Fig 8 shows the Autism Prediction Result from the Autism Detection System. The result indicates a diagnosis of "No Autism" based on the inputs provided in the form. The Autism Risk Score, derived from the form responses, is 0.3, suggesting a low risk for autism. The Model Prediction Probability is 0.2, reflecting the model's low confidence in diagnosing ASD. The Image Prediction identifies the individual as "Adult healthy" based on the uploaded image, which aligns with the form input. Finally, the Final Decision is "Autism Not Detected (Score: 0.3)", which confirms that the individual is not likely to have ASD. The output concludes with the user being

International Research Journal on Advanced Engineering Hub (IRJAEH)
e ISSN: 2584-2137
Vol. 03 Issue: 06 June 2025
Page No: 2862-2868
https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2025.0422

able to go back to the previous screen to make any further adjustments or view more information.

Conclusion

The project on "autism spectrum disorder" Detection Using Machine Learning and Facial Analysis" shows promising solution for the improvement of early detection through technology-based systems. Through the application of machine learning models with the support of behavioural questionnaire analysis and facial image processing, the system delivers an effective mechanism for risk. The use of multiple sources of data guarantees more accurate and reliable predictions than conventional single-method screenings. The capability of the system to forecast ASD risk based on both structured questionnaire inputs and visual factors is its potential for scalable, real-world applications. The suggested solution is user-friendly, adaptive, and compliant with the growing demand for early intervention in developmental disorders. In general, this project shows the significance of integrating machine learning methods with behavioural and facial analysis to develop an accessible, accurate, and effective tool for autism detection, providing a new breakthrough in healthcare technology.

Reference

[1]. Tyagi, B., Mishra, R., & Bajpai, N. (2018). Machine learning techniques to predict autism spectrum disorder. IEEE PuneCon 2018, 1–5. doi:10.1109/PUNECON.2018.

[2]. Abitha, R., & Vennila, S. M. (2019). A swarm-based symmetrical uncertainty feature

[3]. selection method for autism spectrum disorders. 2019 Third International Conference on Inventive Systems and Control (ICISC),665-669. doi:10.1109/ ICISC44355. 2019.9036454El

[4]. Cavinato, L., Cardinaux, A., Jain, K., Jamal, W., Kjelgaard, M., Sinha, P., & Barbieri, R. (2019). Characterizing autonomic response to arousing visual-auditory multi-modal task in autism spectrum disorder (ASD). 2019 41st Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), 4942–4945.Fang, Y., Duan, H., Shi, F., Min, X. and Zhai, G., 2020, October. Identifying children with autism spectrum disorder based on gaze-following. In 2020 IEEE International Conference on Image Processing (ICIP) (pp. 423-427). IEEE.

[5]. Sharma, A., & Tanwar, P. (2020). Deep analysis of autism spectrum disorder detection techniques. International Conference on Intelligent Engineering and Management (ICIEM), 2020, 455–459. doi: 10.1109/ICIEM48762.2020.91601234o

[6]. Ke, F., & Yang, R. (2020). Classification and biomarker exploration of autism spectrum disorders based on recurrent attention model. IEEE Access, 8, 216298–216307. doi: 10.1109/ACCESS.2020.3040725

[7]. Haweel, R., Dekhil, O., Shalaby, A., Mahmoud, A., Ghazal, M., Keynton, R., Barnes, G., & El-Baz, A. (2019). A machine learning approach for grading autism severity levels using task-based functional MRI. IEEE International Conference on Imaging Systems and Techniques (IST), 2019, 1–5. doi: 10.1109/IST48021.2019.9010151

[8]. Islam, S., Akter, T., Zakir, S., Sabreen, S., & Hossain, M. I. (2020). Autism spectrum disorder detection in toddlers for early diagnosis using machine learning. IEEE Asia-Pacific Conference on Computer Science and Data Engineering (CSDE), 2020, 1–6. doi: 10.1109/CSDE50874.2020.9411541

[9]. Hasan, S. M. M., Uddin, M. P., Al Mamun, M., Sharif, M. I., Ulhaq, A., & Krishnamoorthy, G. (2022). A machine learning framework for early-stage detection of autism spectrum disorders. IEEE Access, 11, 15038–15057. doi: 10.1109/ ACCESS. 2022.3238982.

[10]. Guo, A. Z. (2020). Automated autism detection based on characterizing observable patterns from photos. IEEE Transactions on Affective Computing, 14(1), 836–841. doi: 10.1109/TAFFC.2020.2991234

[11]. Han, J., Jiang, G., Ouyang, G., & Li, X. (2022). A multimodal approach for identifying autism spectrum disorders in children. IEEE Transactions on Neural

Systems and Rehabilitation Engineering, 30, 2003–2011. doi: 10.1109/ TNSRE. 2022.3187654

[12]. Wu, C., Liaqat, S., Helvaci, H., Chcung, S. S., Chuah, C.-N., Ozonoff, S., & Young, G. (2021). Machine learning-based autism spectrum disorder detection from videos. 2020 IEEE International Conference on E-health Networking, Application & Services (HEALTHCOM), 1–6. doi: 10.1109/ HEALTHCOM49281.2021.9398962

[13]. Li, J., Zhong, Y., & Ouyang, G. (2018). Identification of ASD children based on video data. 2018 24th International Conference on Pattern Recognition (ICPR), 367–372. doi: 10.1109/ICPR.2018.8545074

[14]. Liang, Y., Liu, B., & Zhang, H. (2021). A convolutional neural network combined with prototype learning framework for brain functional network classification of autism spectrum disorder. IEEE Transactions on Neural Systems and Rehabilitation Engineering, 29, 2193–2202. doi: 10.1109/TNSRE.2021.3110214