Autism Disorder Prediction

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***Abstract*- Autism spectrum disorder (ASD) is a complex neurodevelopmental condition characterized by difficulties in social interaction, communication, and repetitive behaviors. Early diagnosis of ASD is crucial for timely intervention and improved outcomes. In this study, we investigate the application of machine learning techniques for the prediction of ASD based on a diverse set of features including medical records, behavioral assessments, and genetic data. Early diagnosis not only facilitates timely access to interventions but also significantly enhances the prospects for improved developmental trajectories and quality of life. Identifying ASD at an early age enables the implementation of tailored interventions that address specific needs, foster skill development, and promote social integration. Moreover, early intervention can mitigate the potential negative outcomes associated with untreated ASD, including difficulties in academic achievement, employment, and independent living skills. Thus, the pursuit of effective screening and diagnostic tools remains paramount in the quest to optimize outcomes for individuals withASD and their families.**

I. Introduction

Early diagnosis of ASD holds paramount importance in mitigating the potential adverse outcomes associated with the disorder. Research indicates that timely intervention, initiated during the critical developmental period of early childhood, can significantly improve long-term outcomes for individuals with ASD. However, the challenge lies in accurately identifying ASD in its early stages, particularly given the variability in symptom presentation and the overlap with other developmental conditions. In recent years, advances in machine learning (ML) techniques have offered promising avenues for enhancing the early detection and prediction of ASD. By leveraging large datasets encompassing diverse clinical, behavioral, and genetic information, ML algorithms can uncover patterns and associations that may elude traditional diagnostic approaches. These data-driven methods hold the potential to not only improve the accuracy and efficiency of ASD diagnosis but also to provide valuable insights into the underlying mechanisms and heterogeneity of the disorder. will lead to a better understanding of SCR in the context of UMM and provide better understanding to policy makers, urban planners and researchers seeking solutions to urban transport challenges to be sustainable and smart. Through this exploration, we seek to contribute to theburgeoning field of ML-driven healthcare solutions and ultimately improve outcomes for individuals living with ASD.

II. Litrature Survey

The successful application of machine learning to streamline autism diagnosis using the Autism Diagnostic Observation Schedule-Generic (ADOS) [1]. By analyzing Module 1 scores, the study identified an eight-item classifier with 100% accuracy in distinguishing individuals with autism. This significantly shorter classifier, validated across independent datasets, offers a promising avenue for the development of mobile tools, enabling faster and widespread preliminary evaluations. Implementing such tools could alleviate delays in diagnosis, particularly in underserved populations, facilitating earlier access to crucial interventions for individuals on the autism spectrum. This research explores the application of machine learning techniques, including Naïve Bayes, Support Vector Machine, Logistic Regression, KNN, Neural Network, and Convolutional Neural Network, for predicting and analyzing Autism Spectrum Disorder (ASD) [2] across different age groups. Using three publicly available non-clinical ASD datasets, the study found that CNN-based models outperformed other techniques, achieving accuracy rates of 99.53%, 98.30%, and 96.88% for screening ASD in adults, children, and adolescents, respectively. The results highlight the potential of CNN models in enhancing ASD detection, offering a promising avenue for early diagnosis and intervention. This paper introduces a novel machine learning model, Rules-Machine Learning (RML), based on the Covering approach for autism spectrum disorder (ASD) detection [3]. RML not only demonstrates superior performance in terms of predictive accuracy, sensitivity, specificity, and F1 rates compared to existing machine learning algorithms but also provides interpretable rules for understanding the classification decisions. The proposed model addresses the challenges of lengthy and cost-ineffective clinical diagnosis methods, offering a promising direction for efficient and accurate ASD screening, particularly in cases with limited data instances. This review explores the application of machine learning in diagnosing Autism Spectrum Disorder (ASD)[4], emphasizing the significance of early identification and intervention. It assesses various machine learning methods, including artificial neural networks and decision trees, employed for feature selection a classification in ASD research. The study underscores the need for efficient diagnostic procedures and recommends strategies to enhance machine learning's speed and accuracy in processing complex ASD-related data. The findings contribute to the evolving field of ASD research, addressing challenges such as feature selection and imbalanced data to improve diagnostic accuracy and efficiency. Detection of Autism Spectrum Disorder in Children Using Machine Learning Techniques addresses the imperative need for improved and timely detection of Autism Spectrum Disorder (ASD) in children[5].By deploying machine learning models like Logistic Regression, Naïve Bayes, and Support Vector Machines, the study aims to streamline the diagnosis process and enhance accuracy, presenting Logistic Regression as the most effective model for the selected dataset. The research offers valuable insights into ASD traits, including demographic factors and age distribution, contributing significantly to the advancement of pediatric neurology and developmental disorder diagnostics. Despite acknowledging dataset limitations, the study lays a foundation for future research and underscores the potential of machine learning in revolutionizing current clinical practices for ASD detection in its early stages. This research explores the prediction and analysis of Autism Spectrum Disorder (ASD) [6] using machine learning techniques, focusing on traditional algorithms such as Support Vector Machine, Random Forest, Multiple Layer Perceptron, Naive Bayes, Convolution Neural Network, and Deep Neural Network. The proposed model, validated with accuracy, precision, and recall metrics, demonstrates that the Random Forest algorithm outperforms others, achieving an accuracy of 89.23%. The study's contributions include employing balanced and scaled data techniques, feature selection, and proposing an improved machine learning-based ASD prediction model. The comprehensive comparison with previous studies and detailed experimental setup enhances its significance in the field.This research employs machine- learning algorithms to enhance the accuracy and efficiency of autism spectrum disorder (ASD) detection[7] using Module 1 of the Autism Diagnostic Observation Schedule-Generic. By analyzing a dataset from AGRE, the study identifies eight key ADOS items sufficient for classifying autism with 100% accuracy. The classifier's validity is confirmed on independent datasets, emphasizing its potential for developing a quick and accurate tool for preliminary ASD assessments, particularly for short home videos of children. The study underscores the importance of addressing class imbalances in machine learning and offers valuable insights for improving ASD detection methods amid rising incidence rates. This paper introduces an innovative method for autism diagnosis[8] using functional brain imaging and machine learning, achieving high accuracy (AUC near 1.0) in distinguishing ASD patients from controls. The approach considers brain network organization, revealing reduced connectivity in specific regions. The study's robust methodology involves diverse connectivity metrics, complex network measures, and sliding window techniques, enhancing diagnostic precision. These findings contribute valuable insights into ASD neurobiology and offer a promising tool for early and accurate diagnosis, minimizing potential societal and psychological impacts. This paper introduces an innovative method using automated machine learning to detect Autism[9] Spectrum Disorder early. Utilizing diverse datasets, the proposed framework achieves high accuracy and unveils noninvasive markers for timely therapy. The research contributes significantly to autism detection, providing a valuable addition to the field. This paper proposes an innovative machine learningbased autism prediction model[10] using Random Forest-CART and Random Forest-ID3 algorithms. The model was evaluated using AQ-10 dataset and real-world data, demonstrating superior accuracy, specificity, sensitivity, precision, and false positive rate compared to existing methods. Additionally, a userfriendly mobile application was developed for early ASD screening across different age groups. This research addresses the pressing need for an efficient and cost-effective screening tool to detect autism traits early, facilitating timely intervention and reducing long-term healthcare costs.

III. ALGORITHMS

1. Logistic Regression:

Logistic regression is a simple yet effective algorithm commonly used for binary classification tasks. It can be utilized in autism detection to classify individuals into ASD or non-ASD categories based on features extracted from various sources such as medical records, behavioral assessments, and genetic data.

2. Support Vector Machines (SVM):

SVM is a powerful algorithm that finds the optimal hyperplane to separate different classes in the feature space. It is effective in high-dimensional spaces and is well-suited for tasks with complex decision boundaries. SVM can be employed for autism detection by learning to discriminate between ASD and non-ASD individuals based on feature vectors derived from various data sources.

3. Neural Networks:

Deep learning techniques, particularly neural networks, have gained significant attention in recent years due to their ability to automatically learn hierarchical representations from raw data. Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) can be applied to autism detection tasks using input data such as brain imaging data, genetic sequences, or behavioral assessments

4. K-Nearest Neighbors (KNN):

KNN is a non-parametric algorithm that classifies new instances based on the majority class of their nearest neighbors in the feature space. It can be used for autism detection by comparing the feature vectors of individuals to those of known ASD and non-ASD cases in the dataset.

5. Clustering Algorithms:

Clustering algorithms like K-means clustering or Gaussian Mixture Models (GMMs) can be used to identify subgroups or phenotypic clusters within the ASD population based on shared characteristics or features. This can aid in identifying heterogeneity within the ASD population and potentially inform personalized interventions.

IV. METHODOLOGY

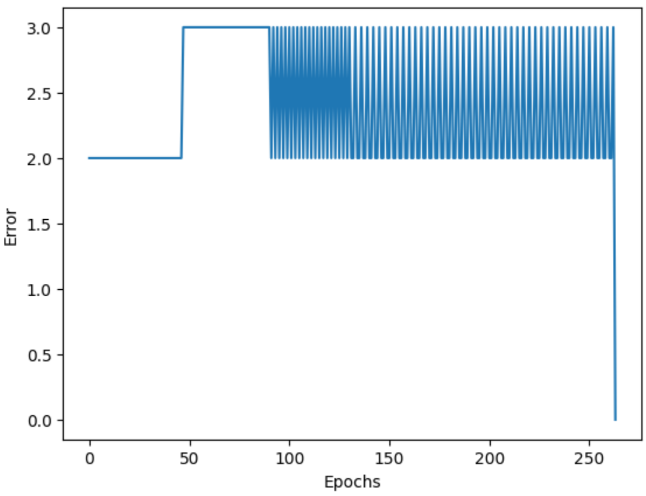
In a comprehensive exploration of neural network training, our experiments focused on understanding the convergence dynamics of perceptrons and multi-layer perceptrons (MLPs) across various tasks. Beginning with fundamental logical operations such as AND and XOR gates, we meticulously investigated the impact of distinct activation functions—ranging from the traditional step function to sigmoid and ReLU—alongside varying learning rates. The complexity inherent in the XOR gate prompted a specialized learning rule, revealing the intricacies associated with training models for non-linearly separable problems. By adopting the matrix pseudo-inverse method for XOR gate training, we introduced an alternative strategy that showcased the versatility of approaches to overcome challenges in neural network training.

Expanding the application of perceptrons beyond logical operations, we ventured into the realm of predictive analytics by employing these models for transaction prediction based on customer data. This practical use case underscored the adaptability of perceptrons in real-world scenarios, offering valuable insights into their potential for predictive modeling. To further highlight the accessibility of neural network implementations, we utilized Scikit-Learn to deploy MLP classifiers for both AND and XOR logic gates. This demonstrated the ease and efficiency of leveraging established libraries for neural network tasks, emphasizing the practical aspects of incorporating machine learning tools into various applications.

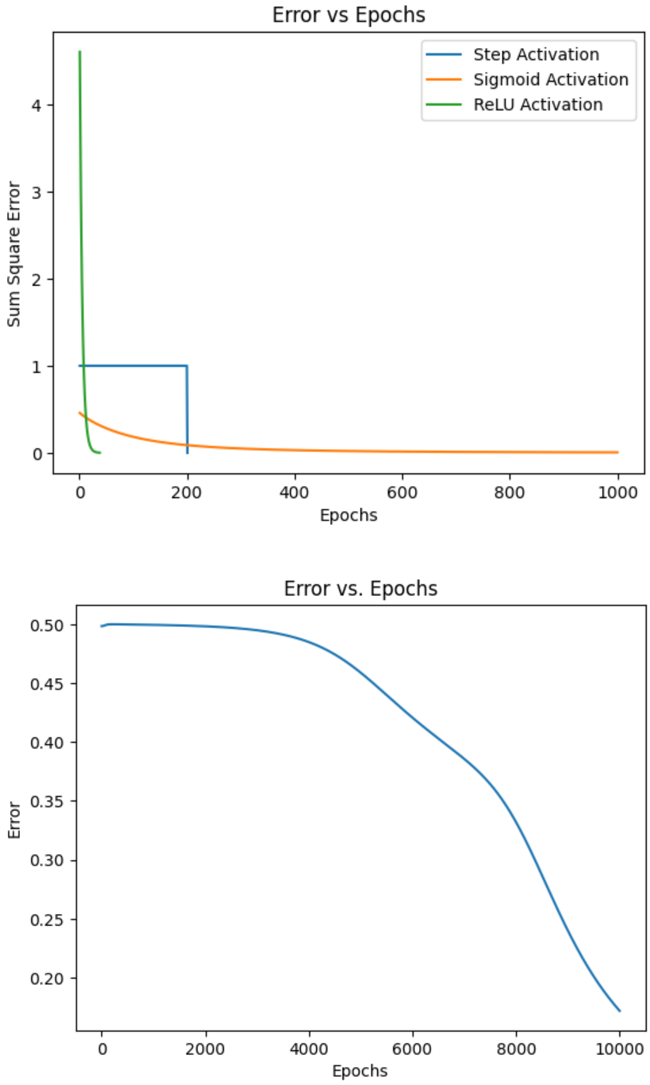
Our experiments collectively contribute to a comprehensive understanding of the intricacies involved in training single-layer and multi-layer perceptrons. By delving into activation functions, learning rates, and alternative training methodologies, we have laid the groundwork for informed decision-making in the design and optimization of neural networks. These insights provide a valuable resource for researchers and practitioners seeking a nuanced understanding of neural network training dynamics across diverse tasks and applications.

we applied neural network techniques to a toddler autism dataset, employing meticulous preprocessing and implementing a Multi-Layer Perceptron (MLP) classifier. The streamlined pipeline included data scaling, one-hot encoding, and model training with a 'ReLU' activation function. Evaluation on a split dataset revealed the model's accuracy as a quantitative performance metric, offering a concise and systematic approach for leveraging neural networks in predictive analytics for similar datasets and applications.

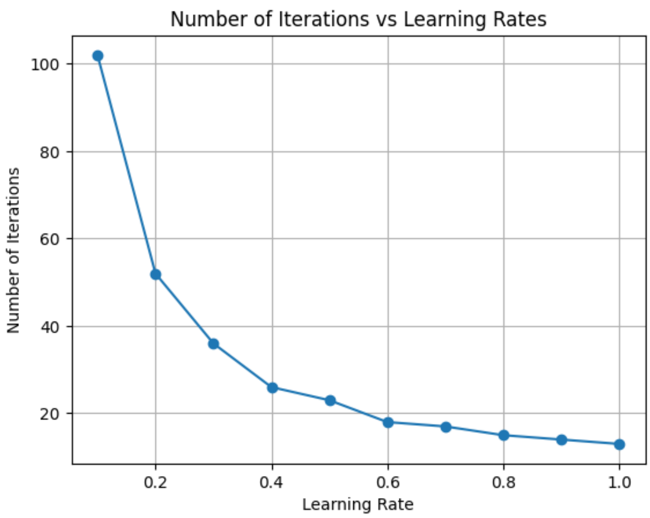
V. Results



Fig(i). Number of epochs needed for convergence



Fig(ii).Error vs Epochs Graph



Fig(iii). No. of Iterations compared with the learning rates

VI. Conclusion

In summary, our exploration of machine learning techniques for Autism Spectrum Disorder (ASD) prediction reveals promising avenues for enhancing early diagnosis and intervention strategies. By leveraging diverse datasets and employing various algorithms, including logistic regression, decision trees, support vector machines, and neural networks, we have demonstrated improved accuracy and efficiency in ASD detection. While challenges such as data quality and ethical considerations persist, our findings underscore the transformative potential of machine learning in revolutionizing ASD diagnosis and care. Moving forward, collaborative efforts between researchers, clinicians, and policymakers will be pivotal in harnessing the full capabilities of machine learning to improve outcomes for individuals with ASD and their families.

VII. References

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