

A Comparative Analysis of Autism Spectrum Disorder Detection with Various Machine Learning Algorithms

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ABSTRACT - Over several decades, The Autism Spectrum Disorder (ASD) is fast growing disorder among children and adults. And Autism Spectrum Disorder is very complex neurodevelopmental disorder that exhibits sluggish progress in Linguistic, Social Interaction with peoples and repetitive disoriented behaviour. Some diseases are characterized by persistent deficits in brain activity. the early-stage detection of Autism Spectrum Disorder is very expensive and time consuming and unfortunately, there is no theoretic method to heal ASD. The increases within the number of autoimmune influenza and ASD cases within the world reveals an urgent got to develop easily applied screening methods. But if it is detected earlier the autism decreases as well. This paper focused on to reviewed with various machine learning algorithms to detect and find the symptoms in earlier stage of Autism Spectrum Disorder in all age people. The evaluation results showed that J48 classification algorithm, Support Vector Machine (SVM) and Convolutional Neural Network (CNN) algorithms are providing better results in the term of Accuracy, Specificity, Sensitivity, Precision and False Positive Rate for both kinds of dataset.

KEYWORD

Machine Learning, Autism Spectrum Disorder, Support Vector Machine, J48, Convolutional Neural Network.

I. INTRODUCTION

The Healthcare Industry, that has adopted numerous algorithmic approaches and methods to discover or predict many disease [1] In this context, many researchers were focused on developing machine learning algorithms in order to achieve their better result in accuracy and other parameters [3]. The brain diseases such as Autism Spectrum Disorder (ASD) is a neurological disorder where it appears in human beings during the first three years and it has been increasing interest to researchers over the past few years[4]. The Autism Spectrum Disorder is known as cerebral disease that involves some common symptoms of social interaction, cognitive functions, repetitive behaviours, communication and adaptive skills [5]. The studies from various neuroscience domain indicate that the biomarkers of ASD are still unknown however the corpus callosum and intracranial brain volume holds significant information for its detection. Individuals with ASD face some difficulty of understanding other's feelings and thinking naturally. Totally 270 individuals have ASD around the world its reported by WHO (World Health organization) [6]. However, the recent and past has witnessed a rise in the number of ASD cases. In 2020, the CDC (Centers for Disease Control and prevention) reported that approximately 1 in 60 children in U.S.A is diagnosed with an Autism Spectrum Disorder [7]. Each individual with Autism Spectrum Disorder has some unique characteristics, and mostly somebody have exceptional abilities in academics, musical skills and visuals. In this case, the most important aspects are required to detect ASD and to ensure proper treatment as early as possible. The main purpose of this review is to enlighten researchers on the state- of -the-art in ASD research, where computational methods have been applied to study the data of analysis and detect the ASD and its related disorders. This survey paper presents various machine learning algorithms were compared analyzed to detect ASD in earlier stage.

STATE-OF-THE- ARTS

The Google Scholar and IEEEExplore were employed to search for articles related to the following keywords: Machine Learning, Deep Learning, Data Mining, Computational Method, Artificial Intelligence, Data science, Autism research, Text mining, ASD related disorders and Image Mining. Searches were limited to articles published between 2015 and 2020 [8]. And Autism Spectrum Disorder (ASD) is a neuro developmental disorder marked by interaction with ither and repetition be process on same thing. The main aim of this reviewed paper is to identify the objectives and top most algorithms were applied to detect ASD as early as possible.

II.LITERATURE REVIEW

S.No	Author Details with Year	Algorithms and Method	Description	Result
1	Alarifi and young 2018 [9]	Used multiple Machine Learning algorithms to predict ASD in Childrens	SVM,MLP,RF and Logical Regression classifier algorithms are used to analyse the data from UCI Repository AQ 10 child test	The MLP algorithms achieved accuracy level of 63.5%
2	Heinsfeld, Franco et.al 2018 [10]	Deep learning algorithms applied to identify ASD	Two stacked denoising autoencoders were used for feature selection followed by a MPNN and Deep learning network for classifying ASD patients and used ABIDE dataset.	Deep neural network achieved 70% accuracy in identification of ASD versus control patients in the dataset. The patterns show an anti-correlation of brain function between anterior and posterior areas of the brain
3	Eslami et.al., 2019 [11]	Proposed ASD-DiagNet: A Hybrid Learning Approach for Detection of Autism Spectrum Disorder Using fMRI Data	ASD- DiagNet was proposed using autoencoder and single layer perceptron for detection of ASD from fMRI data and ABIDE dataset including 1,035 subjects coming from 17 various brain imaging centres.	ASD – DiagNet machine learning algorithms achieved 82 % of accuracy
4	Abdullah et.al 2019 [12]	Evolution of machine learning algorithms to classify ASD	Feature selection – Chi-square, LASSO along with Classification algorithms and Logistic Regression, Random Forest and K-Nearest Neighbour were applied by UCI repository dataset in AQ (Autism Spectrum Questionnaire)	Logistic Regression LR4-chi square model gave highest performance, with 97.541% accuracy, 96.591% specificity and 100% sensitivity
5	Xu et.al 2019 [13]	Prediction in Autism Spectrum Disorder by Deep Learning Short-Time Spontaneous Hemodynamic Fluctuations	Feature extraction and classification is done using a multilayer neural network called CGRNN generated by combining a CNN and GRU with real time dataset were collected from 25 ASD and 22 typically developing children through functional infrared spectroscopy	Using this proposed Deep learning neural network algorithms achieved 92 %
6	Parikh et.al 2019 [14]	The optimized Machine Learning Algorithms and Personal	Totally six personal characteristics of Age, Sex, Handedness and three individual measures of IQ	Neural networks algorithms achieved highest level of

		Characteristics Data (PCD)	from 851 subjects in the ABIDE database were analysed and applied by nine different machine learning algorithms to evaluate ASD and Non-ASD participants.	accuracy 62 % in the binary classification.
7	Omar et.al. 2019 [15]	Machine learning algorithms to predict ASD	Decision Tree and Random Forest algorithms merged with CART and ID3 were evaluated on the 3 datasets from UCI repository and ASD screening for Adult and Children in 100 ASD and 150 Non-ASD cases were identified to analysed the data.	Random forest with CART and ID3 algorithms were given highest level of accuracy 90 % on both UCI repository dataset as well as real time dataset.
8	Lee et.al. 2019 [16]	Various machine Learning algorithms were compared to surveillance of autism spectrum disorder	Latent Dirichlet Allocation (LDA), Latent Semantic Analysis (LSA), Multinomial Naive Bayes (MNB), Support Vector Machine (SVM) with a linear kernel, interpolated naive Bayes SVM (NB-SVM), and neural networks. Data was collected from Medical and Educational evaluations for Public Health Surveillance	Deep learning models and traditional machine learning methods showed comparable performance in predicting the clinician-assigned case status for CDC's autism surveillance system
9	Raj and Masood ,2020 [17]	Analysis and Detection of Autism Spectrum Disorder Using Machine Learning Techniques	Totally five different classification algorithms were applied such as Logistic Regression, SVM, Naïve Bayes, Artificial Neural Network and CNN. With Three datasets of UCI Repository - 3 datasets- ASD screening for Adult, Adolescent and Children	Convolutional Neural Network CNN achieved the highest accuracy of 98.3% on all the three datasets.
10	Abbas et.al 2020 [18]	Multi-modular Artificial Intelligence algorithms used to Streamline Autism Diagnosis in Young Children	Three machine learning approaches were examined with feature selection. ADOS (Autism Diagnostic Observation Schedule) and ADI (Autism Diagnostic Interview) Repositories, real time videos, parental and clinician screening	ROC AUC of 0.83 was given better results.
11	Niu, Guo et.al 2020 [19]	Multichannel Deep attention Neural Network (DANN)	Automated diagnosis of ASD using Deep Learning methods .809 subjects from ABIDE repository, 408 ASD subjects and 401 TC subjects.	DANN classifier performed well and achieved a highest level of accuracy 73% which was higher than SVM and RF.
12	Kunda, Zhou et.al 2020 [20]	A new measure called Tangent Pearson was	Enhancing multi-site autism classification by site-	Extracting second-order features from

		proposed to minimize the site dependence of Functionally Connective features to improve classification.	dependence minimization and second-order functional connectivity. 1035 records from 20 sites of ABIDE dataset, 505 ASD and 530 TC subjects	neuroimaging data and minimizing their site dependence on the ABIDE dataset, achieved a classification accuracy of 73%
13	T.Amalraj Victoirel et al, 2021 [21]	To detect ASD with keas neural network, logistic regression, decision tree classifier, naive bayes, support vector machine and gradient boosting.	This work examines the power to detect ASD using machine learning algorithms while considering the smallest amount number of tests or features.	Logistic regression gives more accuracy of 0.977 than other classification algorithms
14	NaouelBoughattaset al, 2022 [22]	Various machine learning algorithm to predict ASD from normal people.	SVM, LSTM (Long, short term Memory) and CNN classifier algorithms with evaluation of ABIDE dataset	The comparative analysis shows that CNN classifier has given better accuracy of 95 % than SVM and LSTM.
15	Mousumi Bala et al, 2022, [23]	Machine learning Algorithm to detect ASD in individual age group.	Various classifier of NB, BG, CART, KNN, C4.5, KS, SVM, and RT were employed to classify autism at an early stage.	The following classifier algorithms has given better accuracy SVM, KS, KNN, and NB.

III.CONCLUSION

In this conclusion, various machine learning algorithms were compared and analysed to produced efficient results for detection of early-stage prediction of Autism Spectrum Disorder (ASD) at individual groups. Since the diagnosing of ASD is cost effective and time-consuming procedure, if it is often postponed due to the difficulty of detecting autism in children and adults. In this process, machine learning algorithms are efficient to detect autism at an early stage very efficiently. However, this model was not trained with various multivariate / dimensional datasets and explored significant attributes. In the future, it will combine this framework with advanced technologies and develop more and more efficient Autism Spectrum Disorder (ASD) diagnosis system. This system will be applicable for early-stage detection of ASD as early as with low cost.

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