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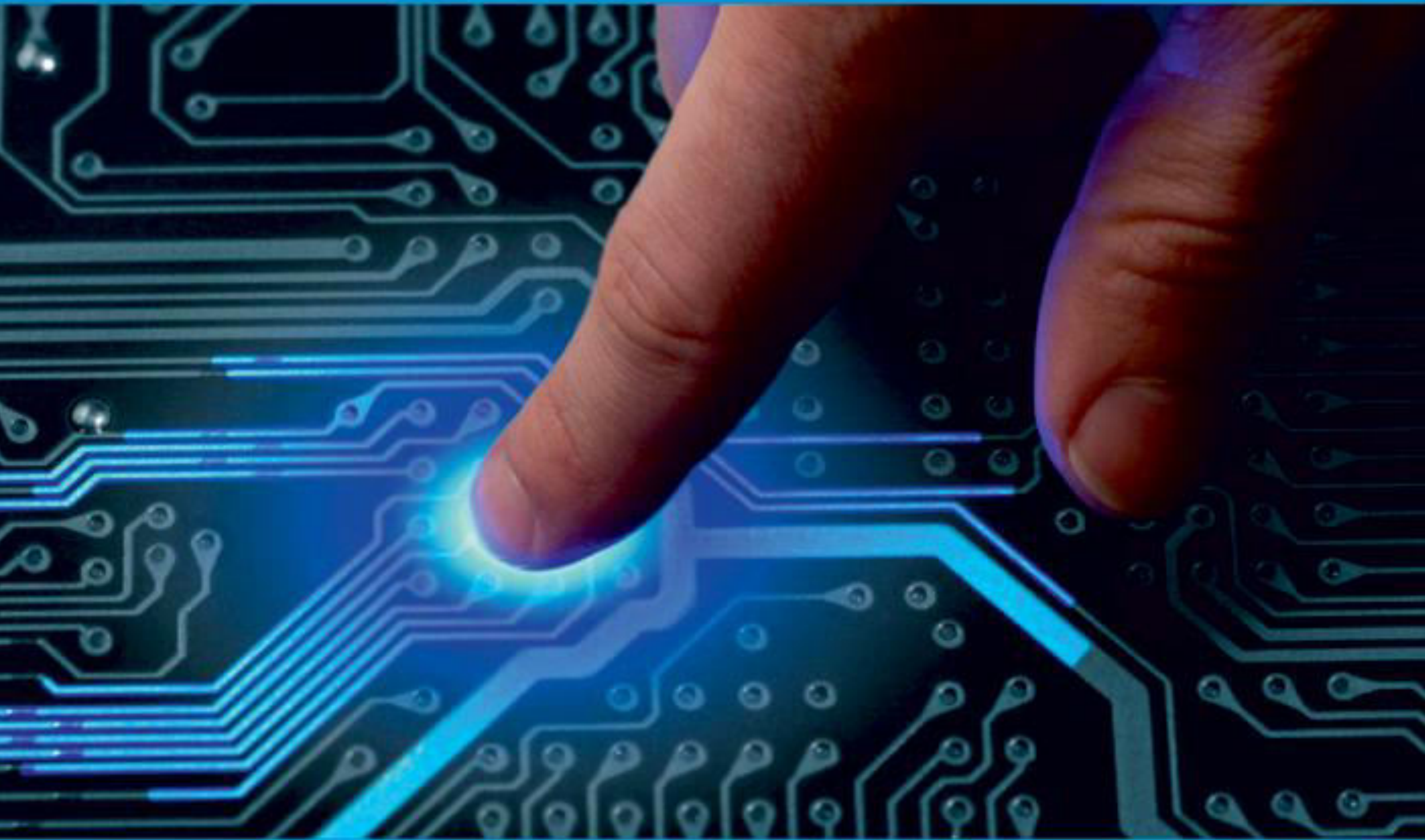

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Machine Learning Applications in Prognostic Modeling for Autism Spectrum Disorder: A Comprehensive Review

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ABSTRACT: Autism Spectrum Disorder (ASD) is a major effect on an individual's capacity to learn, communicate, and connect to other people. While symptoms of ASD can be identified at any age, they typically start showing up in the first two years of life and increase over time. The emphasis issues, learning disabilities, mental health issues like anxiety and depression, physical disabilities, and sensory sensitivity are among the issues that people with autism face. Autism diagnosis requires extensive time and financial resources. Early symptom recognition is essential for prompt intervention, enabling the right medication, stopping the condition's progression, and reducing long-term expenses associated with a delayed diagnosis.

To address these challenges, an imperative exists for an effective, precise, and user-friendly screening tool proficient in predicting autism traits. The goal of this paper is reviewing a machine learning model to identify autism spectrum disorder in both genders. The model incorporates different variables and the Autism Quotient Tool. Results from this study have the potential to accelerate diagnosis, halt the disease's progression, and reduce long-term expenses associated with delayed diagnosis.

Essentially, the objective is to furnish a tool that facilitates early autism identification, ushering in timely support and intervention to mitigate the risk of subsequent complications, including the onset of Alzheimer's disease.

KEYWORDS*:* ASD Symptom, Screening Tool, Learning Disabilities, Mental Health Challenges ,Ethnicity and Autism.

I. INTRODUCTION

This review paper delves into the development of a model aimed at enhancing the prediction of Autism Spectrum Disorder (ASD) in individuals, facilitating timely diagnosis and subsequent treatment planning. Leveraging the Autistic Spectrum Disorder Screening

Data [13], this study explores diverse factors influencing the accuracy of disorder prediction. Employing sophisticated machine learning algorithms such as decision tree, random forest, logistic regression, support vector classifier, and artificial neural networks, the research seeks to identify the optimal model for each dataset. The datasets offer nuanced insights, providing a comprehensive understanding of the complexities involved in predicting ASD.

To assess the effectiveness of each model, a range of performance metrics are employed, allowing for a thorough analysis and comparison from various perspectives. By scrutinizing these models from every conceivable angle, the paper aims to contribute to the advancement of ASD prediction tools. The ultimate objective is to develop a robust and reliable model that not only aids in early ASD detection but also guides the formulation of tailored intervention strategies. This review paper synthesizes existing knowledge and research, paving the way for a more comprehensive understanding of the predictive models in ASD diagnosis.

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II. LITERATURE REVIEW

[1] A. R. Mohamed Shanavas and M. S. Mythili. In 2014, researchers published " a research project employing classification methods to examine autism spectrum diseases." (IJSCE)

A study team lead by M. S. Mythili and A. R. Mohamed Shanavas [1] uses classification algorithms to investigate Autism Spectrum Disorder (ASD). Classifying the degree of autism and tackling related issues are the main objectives of their investigation. In order to examine student behaviour and interactions, the research makes use of neural network technologies such as Vector Machine, Fuzzy Logic, and WEKA.

[2] J. A. Kosmicki, D. P. Wall, M. Duda, V. Sochat (2015) published a paper titled "Searching provides a basic collection of behaviors for feature-based machine learning for autism detection. "Psychological translation.

Researchers V. Sochat, M. Duda, J. A. Kosmicki, D. P. Wall, and associates [2] have developed a technique to identify a limited number of traits for autism screening. In this investigation, they evaluated clinical ASD studies using a machine learning methodology. They assessed a subgroup of kids exhibiting behaviours associated with autism spectrum disorders using the Autism Diagnostic Observation Schedule (ADOS).The ADOS is composed of four modules. To discover stepwise backward characteristics, 4540 individuals' score sheets were analysed using eight different machine learning techniques in this study. The technique showed accuracy rates of 98.27% overall and 97.66% per person. They used nine features—selections from twelve behavioural patterns—of the 28 behavioural characteristics in Module 2, three of which were used—to determine the risk of ASD.

[3] Baihua Li, Senthil Purushwalkam, James Meng, Arjun Sharma, and Emma Gowen. In 2017, researchers published "Using imitation to apply an exploratory study on using machine learning to recognize persons with autism."

A. Sharma, J. Meng, S. Purushwalkam, and E. Gowen

[3] used imitation in 2017 to use machine learning classifiers to detect autistic people. Their research sought to explore the basic elements associated with discriminative test conditions and kinematic traits. The dataset, which included a range of hand gestures, was composed of sixteen individuals diagnosed with Autism Spectrum Condition (ASC). They extracted 40 kinematic characteristics from eight imitation scenarios using machine learning approaches.Even though it was conducted on a limited sample, this study shows how useful it is to use high-dimensional data analysis using machine learning for the diagnostic classification of autism. The sensitivity rates attained by RIPPER highlight this method's potential.

[4] R. Sasikala and R. Vaishali. "Using the best behavior sets, a machine learning-based strategy to categories autism. (2018) " Journal of Engineering and Technology International.

Ideal sets of behaviours are used in a strategy that was introduced by Vaishali R and Sasikala R [4] to identify autism. In their work, they used swarm intelligence to assess a binary feature selection wrapper for firefly on a 21-feature dataset of Autism Spectrum Disorder (ASD) diagnoses taken from the UCI machine learning library. The experiment was designed to test the hypothesis that a machine learning model's classification accuracy may be improved by using fewer feature subsets.They identified binary firefly features using single-objective swarm intelligence, and discovered that 10 of the 21 features in the dataset were adequate to differentiate between those with ASD and those without. Using the best feature subsets, the technique's findings showed an average accuracy of 82%–87%, which was quite close to the total average.

[5]"Screening for autism spectrum disorders using ML and the DSM5," Fadi Thabtah, 2017.

The benefits and drawbacks of utilising machine learning to classify ASDs were investigated by the researcher.
The main goal was to draw attention to the shortcomings of the currently used ASD screening techniques as well as the validity of these tools when using the DSM-4 guide rather than the DSM-5 guide.

III. THE PROPOSED METHOD

A subset of artificial intelligence called machine learning (ML) enables computer programmes to become more adept

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at making predictions without explicit programming.There exist four primary methods in classical machine learning through which algorithms are trained to produce precise predictions.

A. Supervised Learning: The labelled datasets that data scientists provide are used to train algorithms in this type of machine learning. These datasets facilitate the algorithm's learning of correlations between variables by including input-output pairs. Throughout the training process, both the input data and the matching output are employed.

B. Unsupervised Learning: These machine learning algorithms operate on datasets that lack labels. The algorithm searches the data on its own, looking for patterns or significant connections. The algorithms find inherent structures in the data, rather than predetermining the data itself or the predictions or recommendations they produce. This process produces the training data.

C. Semi-Supervised Learning: This method, which combines elements of supervised and unsupervised learning, frequently requires feeding algorithms a large amount of labelled training data. Nonetheless, the model maintains its adaptability to independently investigate the data and create its own comprehension of the dataset, integrating aspects of unsupervised learning.

D. Reinforcement Learning: Reinforcement learning is the process of teaching an algorithm to perform a task. It is used to train machines in multi-step processes that are governed by predefined rules. Next, as the algorithm decides on the best course of action, data scientists offer comments, either favourable or negative. The algorithm maintains autonomy in making decisions along the way, even after guidelines are established.

The life cycle of machine learning is described below in order to give a more thorough overview of the process.

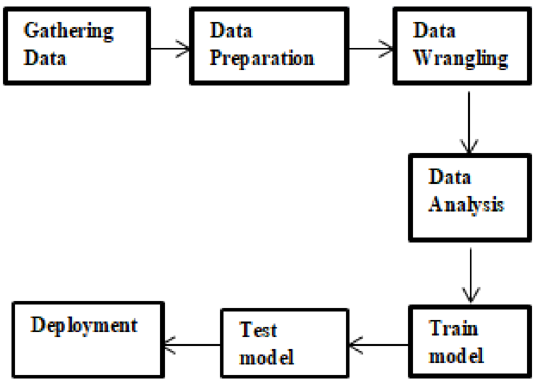

Fig 1 :- Life-Cycle of Machine learning

1. Data Gathering:

- In order to find and fix any problems relating to data, we first gather data. This stage is essential to comprehending the issues that need to be resolved..

2. Data Preparation:

- The data is ready for the following steps once it has been received. Organising the data and preparing it for machine learning training are part of this process.

3. Data Wrangling:

- Cleaning and organising the raw data is similar to data wrangling. It's critical for choosing the appropriate variables, handling quality concerns, and formatting the data so that it can be analysed.

4. Data Analysis:

- After the data has been cleaned, analysis is done. Selecting analytical methods, creating models, and analysing the outcomes to obtain insights are all part of this process.

5. Train Model:

- Here, we use a variety of machine learning datasets and algorithms to train our model. Through training, the model improves its ability to solve problems by comprehending features, rules, and patterns.

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6. Test Model:

- We validate our model using an seperate dataset to see how accurate it is. In order to make sure the model satisfies the project or problem requirements, this step assesses the model's accuracy.

7. Deployment:

- The model's deployment in the actual system is the last stage. We put the model into use if it functions well and runs at a reasonable speed and accuracy. Prior to deployment, we make sure it keeps utilising the data at hand to enhance performance

The machine learning algorithms used in autism research vary depending on the study, and different algorithms may be used for different goals. Several algorithms that are frequently employed in the context of research on autism spectrum disorder (ASD) include:

Neural Networks: Neural networks are incredibly important for the analysis of interaction and behaviour data. They are often used for complex pattern recognition. They are excellent at understanding the inherent patterns these kinds of datasets contain.

Support Vector Machines (SVM): SVM is a robust algorithm that is well-known for its effectiveness in classification tasks. Its use is helpful in accurately classifying and differentiating between different levels of autism severity.

Fuzzy Logic: Fuzzy logic is used to navigate uncertainty and imprecision in data. It offers a sophisticated method of capturing variations and subtleties that are frequently present in behavioural datasets.

WEKA (Waikato Environment for Knowledge Analysis): WEKA is a commonly used set of machine learning tools. It includes a variety of algorithms designed for data mining and analysis, enabling researchers to choose particular algorithms in WEKA that meet the needs of their investigations.

Decision Trees: Decision trees provide an organised method for analysing and classifying various aspects of autism-related data because they are specifically designed for classification purposes. They deliver an organised structure for knowing detailed datasets.

Random Forest: Random Forest is an effective ensemble learning technique that can handle large and complex datasets. It is useful for feature selection and classification tasks as well, and is especially helpful in complicated analytical scenarios.

Machine Learning Classifiers: This class of algorithms, which includes a variety of classifiers like Naive Bayes and k-Nearest Neighbours (k-NN), is selected according to the particular goals of the research study and the different characteristics of the data. Their use is dependent on the complexity of the dataset and the analysis's desired outcomes.

IV.CONCLUSION

This review study has given significant insight on how machine learning can help with the difficulties caused by autism spectrum disorder (ASD). The thorough analysis of different machine learning techniques, even though no actual findings are provided, emphasises the importance of continued research in this field.The potential of machine learning strategies is highlighted by the investigation of various data mining techniques and their application in medical datasets, even in the lack of particular outcome metrics. Although they have been used in the past, traditional machine learning techniques are recognised for their shortcomings in producing exact results, with outcomes differing depending on the prediction methodologies selected.

It is clear that the field of machine learning holds potential in furthering our understanding and categorization of ASD, even in the lack of specific results. The difficulties raised, especially with the representation of different autism classes, present opportunities for further study and advancement in the use of machine learning methods. Leveraging machine learning for ASD classification will continue to advance with continued efforts to refine models and methodologies.

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