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A Survey Paper on a Model for Prediction of Autism Spectrum Disorder

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Abstract— *Autism Spectrum Disorder (ASD) is becoming more prevalent today than it has ever been. It is expensive and time consuming to screen for autism characteristics. . Prediction of autism can be done at early stages because of advances in artificial intelligence and machine learning . A clear conclusion has not been drawn despite the numerous studies that have been made using various approaches on the topic of prediction features of autism in terms of different age groups. Consequently, the purpose of this research is to present a useful prediction model based on Machine Learning technique and to create a mobile application for ASD prediction for individuals of any age. As a result of this study, a prediction model for autism was created by combining Random Forest-CART and Random Forest-ID3, and a mobile app was created using the proposed prediction model as a basis. 250 genuine datasets obtained from individuals with and without autistic symptoms were used to evaluate the suggested model. The study revealed that for both types of datasets, the suggested prediction model delivered higher results in terms of specificity, accuracy, precision, sensitivity, and false positive rate (FPR).*

Keywords—*Autism Spectrum Disorder, Machine Learning, Classification and Regression Trees, Iterative Dichotomiser 3,Random Forest.*

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I. INTRODUCTION

ASD, is a neurological condition, which expands to Autism Spectrum Disorder that impairs a person's capacity for socialisation, communication, and interpersonal interaction. Because it can have varied effects on people and to varying degrees, autism is referred described as a "spectrum" disorder. The condition identifies by challenges with social contact and communication along with constrained and repetitive patterns of behaviour, interests, or hobbies that often manifest in early childhood, usually by the age of 3. These issues might be modest to severe, and they might be connected to other behavioural or developmental issues.Autism has no single known cause, although research indicates that genetic and environmental factors may work together to develop the condition. Although there is no treatment for autism, early intervention and therapy can assist a person communicate, socialise, and perform more normally on a daily basis.

ASD is a complex disease that can significantly impact a person's daily functioning as well as overall quality of life. Yet, many people with ASD can learn to control their symptoms and have productive lives with the right support and intervention. Research suggests that a genetic and environmental cocktail is most likely to be to blame, despite the fact that the exact causes of ASD are not yet fully known. ASD cannot be cured, but early diagnosis and therapy can help manage symptoms and enhance outcomes for those who are affected. As part of the ASD treatment plan, patients may also receive occupational therapy, speech and language therapy, behavioural therapy, and pharmaceutical management for any comorbid problems like anxiety or ADHD. Numerous ASD sufferers can learn to control their symptoms and enjoy happy lives with the right assistance and intervention.

II. RESEARCH METHODOLOGY

[1] A neurodevelopmental illness called autism spectrum disorder shows symptoms in behaviours that are commonly seen in the younger people, yet a diagnosis may not be made until maturity. the presence of difficult behaviours can have significant effects on therapeutic treatment models, including

behavioural science in practise (ABA). The provider offered ABA therapy services to 4,315 children in the candidate pool as a consequence of pre-processing. After that, we used filtering criteria to identify the patients who over time consistently displayed problematic behaviour. A sample size of 2,116 individuals was obtained using these criteria. Eighty-two percent of the 2,116 participants were men and seventeen percent were women. This disparity is predicted given that ASD affects men at a rate that is almost four times higher than that of women. The people who participated were 7.48 years old on average (SD = 2.33). We use K-means clustering to identify similar behavioural trajectories among the previously identified categories of problematic behaviours. Before providing the findings of our investigation, in this part we give a brief overview of K-means mathematically.

By locating cluster centroids, the straightforward method K-means establishes cluster membership.While k-means offers an algorithmically simple technique to discover grouping, the main problem is figuring out how many clusters, k, should be simulated. With a population sample as large as 2,116 patients, this paper delivers the first analysis of problematic behaviours, which has machine learning as its basis. We can discover relevant behaviour profiles using K-means clustering, and they show that there is typically a dominant single behaviour in most clusters.

[2] A system has been established to document, recognise, and classify the behavioural patterns of children with autism spectrum disorder (ASD). The system makes use of two different platforms for static and wearable sensors. The wearable device tracks a subject's motions using an accelerometer, while static sensors including microphones and cameras capture images, videos, and audio of people in a location. The film also acts as ground truth for the analysis of data from wearable sensors. Time-Frequency approaches are used to extract characteristics from the accelerometer signal while Hidden Markov Models (HMM) are used to analyse the signal. The Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition states that understanding behavioural patterns is crucial for spotting signs of autism (DSM-IV). Researchers at Georgia Tech have created a method to lighten the effort of therapists as therapy sessions can be highly draining for them. This system makes use of technology to index and buffer video recordings based on user inputs. An audio sensor that can recognise sounds or vocalisations from the subject is needed, and the entire video recording provides ground truth during early research to identify the behavioural patterns so that an intelligent assistance system may be built.

[3] The several studies have used EEG or eye tracking data to classify ASD. Yet for classification, they all merely employ EEG or eye movement data. In our research, we blend eye movement and EEG data to create a productive diagnostic tool. By the use of electrodes positioned at various locations on the scalp, EEG analyses the electrical signals produced by the brain. The analysis of these electrical impulses, which are brought on by postsynaptic activity in the neocortex, is useful for analysing complex neuropsychiatric issues. The EEG conducts its study using a variety of frequency bands with varying bandwidths. To categorise autistic patients, a sophisticated EEG processing technique called MSROM/I-FAST and several algorithms of machine learning are used. A revolutionary method called MSROM is built on the Single Organizing Map Neural Network. Only the training set is used for the noise reduction. It also entirely depends on the feature vector extraction algorithm chosen. They use the TWIST algorithm for MS-ROM features. They employ a variety of machine learning techniques and validation processes in the final classification stage. This study presents the comparison and analysis of eye, EEG, and combined data. 32 models with only EEG data, only eye data in 4 models, and 32 models with both eye and EEG data were all investigated. Still, eye data or mixed data performed better than EEG data. There are many potential areas for development going forward, as well as many more

comparisons that may be made. Also, this will reveal which feature selection approach will be more effective for the merged datasets. With some of the features, Gaussian Naive Bayes had a flawless score.

[4] This paper discusses a ground-breaking control architecture called B3IA that was developed to help create autonomous robot systems that might be used as tools for behaviour intervention for kids with autism spectrum disorders (ASD). Our objective is to offer a method that nonrobotic ASD therapy practitioners can quickly adopt for use. A behavior-based architecture called B3 IA uses human-robot interaction to manage socially assistive robots in the setting of ASD. Because the effectiveness of a robot-assisted intervention relies on the robot's behaviour, we hypothesise that the design of the architecture of robot control is crucial. We describe the elements of B3 IA and show initial findings from experiments that start to test this theory. One of the main goals of ASD treatments is to encourage and promote the growth of social proactivity and spontaneous sharing of experiences. Therefore, the majority of current research focuses on creating strategies for intervention that use carer and therapist behaviour to elicit and encourage social behaviours in ASD children. An autonomous robot-assisted intervention for kids with ASD was presented in this research, along with the

methodology and supporting robot control architecture. The suggested B3 IA makes use of certain activity modelling and history collection modules to monitor the social quality and quantity of social contact between the user and the robot. In order to be employed in a variety of intervention activities and situations, B3 IA's framework is made to be as adaptable as practical. The unusual B3IA components were created to get around the challenges associated with creating autonomous robots for ASD intervention.

[5] A "serious game" is a brain game that uses entertainment to advance public policy, government or business training, health, education, and strategic communication objectives. It follows a set of rules and is played on a computer. "Serious games" refer to digital games and gadgets that have a purpose other than simple enjoyment. Any video game could be considered a game that is serious, based on how it's played and how the player engages with it. In this paper, "serious games" will be defined as digital games that are primarily meant to help players gain certain knowledge or skills for objectives besides being purely entertaining. The term "serious" implies goods utilised in industries including engineering, management, science, defence, healthcare, and the military. Virtual reality, touch screen computers, mobile devices, standalone and online 2D and 3D games, interactive tabletop games, and mobile devices are some of the technologies used in the development of meaningful games for autism. Solving puzzles is the core focus of serious game development. Even while they may be entertaining and stimulating, serious games are mostly employed for instruction, research, or marketing. Serious games for autism have previously had two goals in mind: education and therapy. Serious games can assist in resolving some of humanity's problems, such as autism. This essay presents a comprehensive analysis of the creation of and research into serious games for those with autism. Games are a very successful treatment and educational tool for children with autism, according to research in the literature. Playing serious games can help you through this one-dimensional, narrowly focused assessment. In fact, it is frequently possible to analyse video games by combining numerous classic assessment methods with modern ones.

III. CONCLUSION AND FUTURE WORK

To forecast the features of autism, a prediction model was created.The proposed Merged Random Forest algorithm was implemented using Amazon Web Service in a screening application for Android (AWS).An API was made using AWS that the android app can access. The three iterations of the AQ-10 screening instrument were used as a guide to create distinct questions for various age categories. The proposed model can identify autism in younger people(children), middle-aged (adolescents), and adults with 92.26%, 93.78%, and 97.10% accuracy, respectively, using the AQ-10 dataset. The accuracy performance for the real dataset gave only fair results (77% to 85%). The lack of real dataset was the primary factor contributing to this marginal result.

Based on the suggested prediction models, an application thst is user-friendly for smartphone has been created for users, making it simple for anybody to use the programme to forecast the autistic features. Because the majority of the existing works mainly concentrate on developing and comparing the performance of prediction models or approaches without investing in developing any mobile apps for end users, this result showed an extension of a number of other existing works. The results of this research provide a useful and effective method for identifying autism traits in people of different ages. Because it can be challenging to diagnose autism in children and teenagers, the process of diagnosing the features of autism is sometimes put off**.** With the help of an application for autism screening, a person can receive early guidance, preventing the issue from growing worse and reducing the costs connected with a delayed diagnosis.

The primary research limitation is a lack of sufficient big data to train the prediction algorithm. Children under the age of three are not supposed to use the screening tool because of unavailability of open source data. Our ongoing study will concentrate on gathering more information from various sources and improving the proposed machine learning classifier's precision. In order to assess the smartphone application's usability and user experience (UX), a user survey will also be carried out.

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