Chapter 8
Impact of Machine Learning and Deep Learning Techniques in Autism

Megha Bhushan
https://orcid.org/0000-0003-4309-875X
DIT University, India

Maanas Singal
DIT University, India

Arun Negi
Deliotte USI, India

ABSTRACT

Autism spectrum disorder (ASD) is a behavioural and developmental illness caused by brain abnormalities. Individuals with ASD have difficulty with limited or repeated acts, as well as social communication and participation. Additionally, people with ASD may learn, move, or pay attention in various ways. It should be remembered that some individuals without ASD may also experience some of these symptoms. However, these traits may render life very difficult for those with ASD. Since the trend of machine learning (ML) and deep learning (DL) techniques has been on an onset in every domain, the same is being actively utilized for diagnosis and treatment of this aliment. This chapter provides an in-depth insight into the efforts of researchers on diverse crowd for development and implementation of ML/DL models to assist the ailing individual along with their families and health caregivers. It provides the review of existing works in diverse directions in focus with ASD like prediction, segregation, correlation, etc. between parameters which would help the medical professionals.

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1. INTRODUCTION

Social communication and common behaviour is hampered in many neurologically ailing individuals by the complicated neurodevelopmental disease known as Autism Spectrum Disorder (ASD). The diagnosis of ASD currently places a significant emphasis on qualitative behavioural assessment. Factors like carer report bias and professionals' lack experience identifying ASD may have a detrimental impact on the diagnostic accuracy. Based on a new meta-analysis of data from 35 countries, the mean age of ASD diagnosis was 60.48 months, and when accounting exclusively for children under the age of 10, it was 43.18 months (van't Hof et al., 2021). The prognosis of the affected youngsters is further impacted by the postponed action that results from the delayed diagnosis (Dawson et al., 2012). Both the extent and the intensity of its symptoms are quite variable. Common signs include difficulty communicating, particularly in social situations, obsessional hobbies, and repeated mannerisms. A thorough examination is needed to detect ASD. This also comprises a thorough evaluation and a range of tests conducted by child psychologists and other licenced experts. Autism Diagnostic Observation Schedule Revised (ADOS-R) and Autism Diagnostic Interview Revised (ADI-R) are two common techniques for diagnosing autism (Duda et al., 2014). Low diagnosis and treatment rates in healthcare institutions are another barrier to rapid ASD detection and therapy. In the United States, just 1% of people with ASD are now identified by primary care HCPs (Monteiro et al., 2019; Rhoades et al., 2007). The American Academy of Paediatrics (AAP) advises clinicians knowledgeable with the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) criteria to diagnose ASD or refer patients to a specialist for additional evaluation after a failed ASD screen in primary care (Hyman et al., 2020).

Even with these statistics, 60% of children who fail screenings are neither detected in general care nor directed to a specialist (Monteiro et al., 2019). Primary care diagnosis is frequently hampered by a lack of perceived self-efficacy in making the diagnosis, low confidence in using ASD diagnostic tools due to a lack of specialist training and/or time to administer, and a lack of time to properly review results with carers and discuss treatment recommendations (Fenikilé et al., 2015; Self et al., 2015). Additionally, traditional screening tools used in healthcare contexts may overlook a significant number of instances of ASD. For instance, 61% (278/454) of the kids who received a diagnosis of ASD in a cohort of more than 20,000 kids with outcome data failed a standard screener (Guthrie et al., 2019). Several works have tried to identify and classify ASD using different machine learning approaches. The researchers in (Thabtah & Peebles, 2020) suggested using Rules-Machine Learning (RML) to evaluate the ASD features and discovered that RML improves the performance of classifiers. Similar to how the authors in (Satu et al., 2019) used tree-based classifiers to highlight individual important characteristics of typically developing and autistic children in Bangladesh. In (Abbas et al., 2018), feature encoding approaches were used to address the issues of scarcity, sparsity, and data imbalance. ADI-R and ADOS ML methodologies were merged into a single evaluation. A further work that was published in (Thabtah et al., 2018) offered a CI approach called Variable Analysis (VA), which employed Support Vector Machine (SVM), Decision Tree (DT), and Logistic Reggression (LR) for reliable ASD diagnoses and prognoses (Hossain et al., 2019; Howlader et al., 2018; Thabtah, 2017, 2019); and demonstrated feature-to-feature and feature-to-class associations.

Recent developments in Social Cognitive Neuroscience (SCN) have provided new insights into how people evaluate and describe their ideas, attitudes, and actions (Arya et al., 2022). The branch of study known as SCN investigates biological mechanisms and related cognitive-based elements (Nosek et al., 2011), and it has shown that interpersonal relationships rely on implicit psychophysiological systems