

Different AI Approaches to Address Autism in Children: A Review

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Abstract: *Autism Spectrum Disorder (ASD) is a neuro-developmental disorder. It is a problem that affects a child's nervous system, growth and development. It often shows up during a child's first 3 years of life. To improve the quality of their lives intervention is the only solution for them. Artificial Intelligence (AI) is used in the intervention for children with ASD. The application of AI has been proven to be feasible and effective in the interventions. The research tries to map AI's route to the intervention for children with ASD and find out the needs and the opportunities for combining artificial intelligence and bio-inspired computation within an application domain.*

Keywords: Autism Spectrum Disorder (ASD), Artificial Intelligence (AI), Machine Learning (ML)

I. INTRODUCTION

Autism Spectrum Disorders (ASD) is a condition that impacts child's development in two core areas: the first is the social communication and social interaction and the second is restricted repetitive patterns of behaviour and interests. There are social behavioural deficits that comprise the symptom profile of child with ASD. Autism is a neuro developmental disorder which means disability in the functioning of the brain that affect a child's behaviour, memory or ability to learn. Early detection of autism can help limit the development of the condition but the conventional screening methods are lengthy, time consuming and costly because of this early detection is not possible. A child has ASD from birth, it may not come to attention until social demands exceeds their limits. Young kids with autism don't make eye contact and don't use gestures to communicate their need or to describe something, lack of interest in peers, difficulties in imaginary play, failure to make friends, and adjust one's behaviour to fit the social context. As a kid with autism their tone or pattern of speech may be odd. Boys are more likely to be diagnosed with ASD than girls. Children with autism also frequently have cognitive impairment, sleep disorders, allergies, and digestive problems are commonly seen. The solution to deal with this issue is to develop intelligent AI screening system which will provide accurate pre-diagnostic classification and can improve the efficiency and accessibility of screening process. Many researches reveal that children with ASD are more likely to interact with AI rather than caregivers and peers, because AI seems less disturbing and more simple than human beings. AI can potentially be applied to a large scope of objectives for children with ASD, which functions as a base to guide development of robot interventions which results in children improved in their ability to orient to prompts administered by the robotic system and continued to display strong attention to the humanoid robot.

II. LITERATURE REVIEW

The detection of autism spectrum disorder (ASD) is based on behavioural observations. To build a more objective data driven method for screening and diagnosing ASD, many studies have attempted to incorporate artificial intelligence (AI) technologies. Therefore, the purpose of this literature review is to summarize the studies that used AI in the assessment process and examine whether other behavioural data could potentially be used to distinguish ASD characteristics. To improve the accuracy of outcomes, AI algorithms have been used to identify items in assessment instruments that are most predictive of ASD. Creating a smaller subset and therefore reducing the lengthy evaluation process, studies have tested the efficiency of identifying individuals with ASD from those without. Other studies have examined the feasibility of using other behavioural observational features as potential supportive data. Artificial

intelligence (AI) augments a doctor's ability to diagnose, treat, and understand disease. Medical experts all around the world use AI to address common conditions. Some believe autism will be transformed by the AI revolution, while others believe more research is required before we can truly harness the power of computers to address autism.

III. ARTIFICIAL INTELLIGENCE (AI) TO DIAGNOSE AND TREAT AUTISM

Several researches focus on the functions of AI on the improvement of social abilities of children with ASD. Artificial intelligence (AI) could be used to diagnose autism and help children to improve social, communication, and emotional skills. Diagnosis of autism through the use of AI is now a reality. AI-based therapies are in development while some types of AI therapies such as those that require the use of an interactive robot are not yet available at a reasonable cost but AI-based apps are now downloadable for any smartphone user. Along with learning lifecycle skills AI can also help parents in the early stages of the Autism journey. Early intervention is the biggest factor in determining outcome for children with ASD.

Treatment for ASD includes:

- **Behaviour change programs:** These programs teach social skills, movement skills, and thinking (cognitive) skills. They can help a child change problem behaviour.
- **Special education programs:** These focus on social skills, speech, language, self-care, and job skills.
- **Medicine:** Some children need medicine to help treat some of the symptoms of ASD.

AI covers a wide range of technologies that are capable of performing cognitive functions by mimicking human intelligence. AI is capable of capturing data that may not be visible to the human eye during behavioural observations, which can lead to precise data-fiction. One of the most commonly used subfields of AI is Machine Learning (ML). ML can enhance our understanding of ASD and may further help build a stronger foundation for better screening and diagnosis. To develop a more objective method in identifying ASD, researchers have investigated the feasibility of using AI to capture different types of behavioural features to use as valuable information in detecting characteristics that are unique to individuals with the disorder. With the help of AI, children with autism spectrum disorder can improve their communication and social skills by almost 30 percent. For autistic children's AI and robots are great tutors, children's are more open to AI and robots than they are to humans because they can repeat instructions, stories and answers numerous times, without getting fatigued. Children, in turn, are able to improve their social skills and maintain relationships with the AI-based device.

IV. CHALLENGES FACED BY AUTISTIC CHILDREN'S

Children with autism spectrum disorder (ASD) develop at a different rate and don't necessarily develop skills in the same order as typically developing children. Following are some challenges faced by autistic children's

- **Anxiety,** due to characteristic communication difficulties, an autistic person may have severe anxiety issues but have a decreased ability to express it.
- **Dealing with change,** Children on the autism spectrum can find change very stressful. Due to the behavioural, information processing and sensory aspects of their diagnosis, many children on the autism spectrum often prefer familiar environments with a predictable routine.
- **Difficulty with joint attention** can make it hard for children with ASD to develop communication and language skills.
- Children with ASD find it hard to see things from other people's perspectives.
- Children with ASD can struggle with focus, attention, transitions, organisation, memory, time management, emotional control and frustration.
- Children with ASD have difficulty seeing the 'big picture'. They can get lost in the details, rather than pulling together different sources of information and seeing the situation as a whole.
- **Social and communication problems-** Children with this problem always face problem in socializing and it is difficult for them to interact with other people, it is difficult for them to understand normal human behaviour.

- **Other challenges issues common with children suffering from autism include:** - Noise sensitivity, sleeping problems mood stability and meltdowns and many other issues of daily living.

V. HOW HUMANOIDS AND AI APPLICATIONS ARE HELPING AUTISTIC CHILDREN’S

There are many applications that are helping children with autism in the evaluation, therapy and communication skills. The AI app uses a series of exercises to help the user calm down or respond appropriately and then, depending on the mood of the child, the model offers exercises and then learns how the child responds. Instead of coding with logic you give it a framework within which it can learn, ultimately it starts thinking more like a human being.

5.1 A Humanoid Robot, Nao

A humanoid robot, Nao learns about a child’s behaviour by using two cameras and four microphones to record the child’s facial expression and body language as it interacts. Once it records the data, it carefully assesses the data to figure out the most effective way to gain the child’s attention.

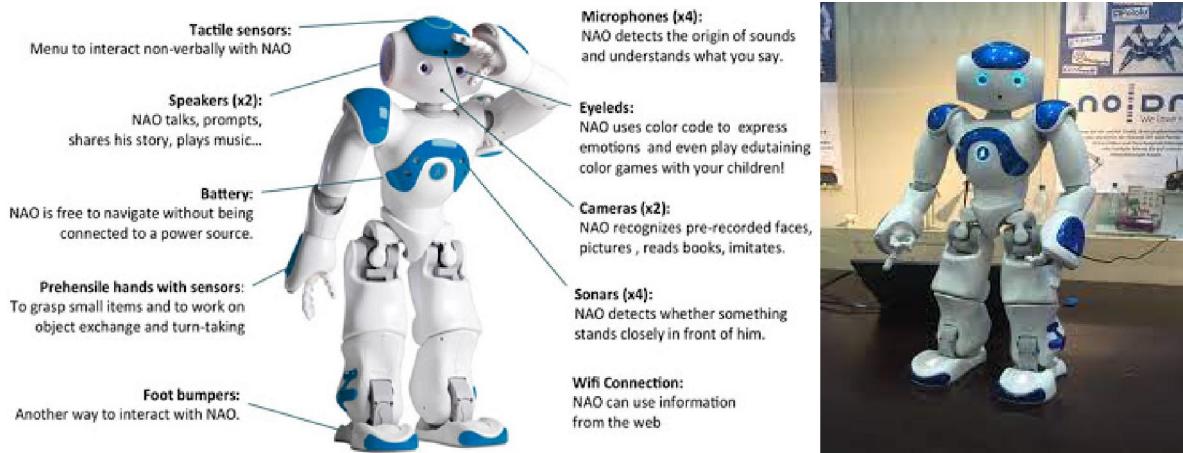


Figure 1: Features of NAO Robot (Source-gigabotics.com) **Figure 1:** NAO Robot (Source – Wikipedia)

5.2 Robokind’s Milo

Robokind’s Milo that shows emotions through facial expressions and can communicate with its own voice, can teach children about social norms. Through applied behaviour, this humanoid robot provides immediate feedback, so that the kids know whether their responses are right or wrong.

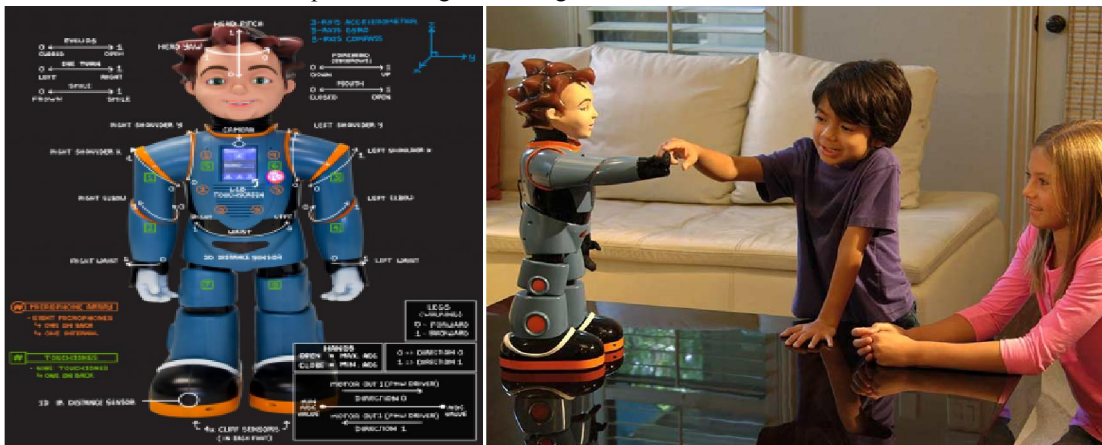


Fig .3. Robokind’s Milo (Source-Robotics Business Review) **Fig .4.** Therapy from robot (Source – Med page Today)

5.3 Identifor Companion App

Identifor Companion app is helping adults and children find employment. It includes an AI-powered virtual assistant called Abby to have real back-and-forth conversations with the users. It learns the routines of users and keeps their school, work and social life on track.

Even virtual assistants like Siri, Cortana and Alexa which aren't designed to cater to these people, have proven to have the right skill sets to communicate with them.

5.4 Cogna

Another use of AI-aided diagnosis is an autism screening tool created by Cognoa in Palo Alto California. This tool is a mobile app that parents can use without the involvement of a trained evaluator; it reviews answers to multiple-choice questions as well as videos of the child.

5.5 The Manatee App

Manatee is a virtual health clinic, is one of the first AI apps offered as a simple, no-cost iPhone download. "The goals are written by clinical psychologists," says Dipayana. "It's recommended that kids do the activities with parents first. There is a step-by-step list that takes it from easy to more advanced skills; the app is intended to be supportive by offering guidance and help with lots of focus on parental involvement."

5.6 Empower Me

Brain Power is a company that's designing AI solutions that respond to emotions. Their flagship product, Empower Me teaches social and cognitive skills to people with autism through emotional recognition. Empower Me runs on any smart glasses. When a child or an adult wears the glasses, it sees and hears special feedback geared toward the situation. The digital coach helps the wearer to interpret facial expressions of emotions, when to look at people and gives feedback of wearer's own state of stress or anxiety.

5.7 Behaviour Imaging

Behaviour Imaging, a Boise, Idaho company, uses a system called the Naturalistic Observation Diagnostic Assessment. This tool is an app which allows parents to upload videos of their children for observation. Initially, clinicians watched the videos to make remote diagnoses; more recently, however, the company has started training AI-like algorithms to observe and categorize behaviours. The algorithms would not diagnose the children but might point clinicians to specific behaviours that might otherwise have been missed.

5.8 Softbank Robotic

Softbank Robotics NAO humanoid robots are about two feet tall and look like science-fiction-style androids. They are capable of expressing emotions by changing the colour of their eyes, moving their arms, and changing the tone of their voice. Children with autism often respond more positively to NAO than to a human therapist, perhaps because NAO (and other robots for autistic children) have unlimited patience and are able to repeat the same cues in the same way over and over again without variation. Many children on the spectrum look forward to their time with and, in some cases, show NAO affection with hugs.

VI. LIMITS OF AI FOR TREATING AUTISM

AI is the new tool for treating the autism and so far the outcomes are limited. AI based robots and apps are available for children with autism and they do have ability to support children as they learn but they also have few shortcomings for example:

- The humanoids robots are playing important role in growth of autistic children's but they are very expensive to make and use.

- Children who can use apps must be able to read and follow instructions. They must also be motivated to comply with a program that offers virtual rewards for a job well done. In other words, even semi-independent use of any app requires a level of functioning and motivation that is well above that of many children with autism.
- Some children are more willing to interact with a robot than with a human, it's not yet clear that those children will be able to transfer their interactive skills to human playmates.
- Apps are not yet integrated into most typical settings. While some therapists and some schools are beginning to embrace the technology, there is a long way to go.

VII. ADVANTAGES OF AI FOR AUTISTIC CHILDREN

- The advancement of socially-assistive robots in recent years has opened up a promising new way for autistic patients to get more affordable and personalized care. In theory, in-home robots could help supplement human therapists by taking over the more repetitive training activities, and AI could help individualize the experience.
- AI-powered robots can also help children with ASD to develop the social skills they need in order to communicate more effectively.
- In many of the researches it has been proved that the Artificial Intelligent robots have helped the children with ASD spectrum disorder to improve in socializing.
- Children with autism often respond more positively to robots than to a human therapist, perhaps because robots for autistic children have unlimited patience and are able to repeat the same cues in the same way over and over again without variation. Many children on the spectrum look forward to their time with and, in some cases, show robots affection with hugs.
- AI can't provide all kinds of therapy, but it's a scalable way to provide care for kids who wouldn't get care.
- The AI app uses a series of exercises to help the user calm down or respond appropriately and then, depending on the mood of the child, the model offers exercises and then learns how the child responds.

VIII. CONCLUSION

This paper is describing the different efforts which have been taken to diagnose and cure autism to certain extent. It is still challenging task to perfectly cure this kind of disease. AI based methods and applications can be successfully applied to analyse and identify the severity of ASD. In this work, we have tried to discuss various different promising efforts which have been done to diagnose and treat ASD to a certain extent. Apart from AI treatment Autism Spectrum Disorder (ASD) also needs proper medication, therapies, parental care and support.

REFERENCES

- [1]. K. Porayska-Pomsta C. Frauenberger H. Pain G. Rajendran T. Smith R. Menzies M. E. Foster A. Alcorn S. Wass S. Bernadini K. Avramides W. Kea, Developing technology for autism: an interdisciplinary approach
- [2]. Muhammad Shoaib Jaliaawala, Rizwan Ahmed Khan, Can autism be catered with artificial intelligence-assistant intervention technology? A comprehensive survey
- [3]. Halim Abbas, Ford Garberson, Stuart Liu-Mayo, Eric Glover & Dennis P. Wall, Multi-modular AI Approach to Streamline Autism Diagnosis in Young Children
- [4]. Seyed Reza Shahamiri & Fadi Thabtah, Autism AI: A New Autism Screening System Based on Artificial Intelligence
- [5]. Emilia Barakova and Tino Lourens, Interplay between Natural and Artificial Intelligence in Training Autistic Children with Robots
- [6]. KAŠKA PORAYSKA-POMSTA, ALYSSA M. ALCORN, Blending Human and Artificial Intelligence to Support Autistic Children's Social Communication Skills

- [7]. Dennis P. Wall, Rebecca Dally, Rhiannon Luyster, Jae-Yoon Jung, Todd F. DeLuca, Use of Artificial Intelligence to Shorten the Behavioral Diagnosis of Autism
- [8]. Justin Bimbrahw, Jennifer Boge & Alex Mihailidis, Investigating the Efficacy of a Computerized Prompting Device to Assist Children with Autism Spectrum Disorder with Activities of Daily Living
- [9]. William L. Jarrold, Treating Autism with the Help of Artificial Intelligence: A Value Proposition