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Humanoid Robot as a Teacher's Assistant: Helping Children with Autism to Learn Social and Academic Skills

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Abstract
Autism Spectrum Disorder (ASD) is becoming a growing concern worldwide. Parents are often not aware of the different nature of children with ASD and attempt to treat him/her the same way as other children. However, that causes more and more isolation of such children from the social interactions around them, resulting in more secluded and people-phobic behaviors. Nevertheless, similar to other children, children with ASD also like to play with toys. This observation has led to the use of toys in a way that mere playful activities could become sources of learning and skill-building, somewhat serving or assisting in the role of a human teacher. Robots have been observed to be fascinating for all children and compensating for a human companion to a certain extent. In this paper, a short study has been presented involving a humanoid robot programmed for a number of teaching and therapeutic behaviors, such as exercises, singing, explaining, and playing with children. Tests were performed on a small group of 15 children with ASD (ages 7–11) using these activities at a local school for children with special needs for a number of weeks. The objective of the study was to quantify the improvement in a number of behavior and learning parameters when children performed the activities with NAO robot present with the teacher, as opposed to the same type of activities performed by the teacher alone. The performance improvement was quantified in terms of the NAO robot activity as independent variable, and following dependent behavioral variables observed from the responses of children: (a) number of trials, (b) activity response time, (c) response type, and (d) behavior retention. Quantified findings from these tests are reported in this paper against average performance values (based on teachers and psychologists' evaluation). The results of the study have been found to be very encouraging which demonstrates the capability of robotic toys to improve the learning process for children with ASD. The results of this study also encourage the low-cost development and usage of such robotic toy systems for teaching and therapeutic applications that help such children to become better members of society.

Keywords Autism Spectrum disorder (ASD) · Human robot Interface (HRI) · NAO robot · Interactive games · Robot-based games

1 Introduction

Autism Spectrum Disorders (ASD) are usually defined as neurodevelopmental disorders in which a person has abnormal social interaction, impaired communication, language difficulties and lack imitational coordination [1]. ASD manifests in diverse actions, behaviors, and appearances, making each individual child a unique experience. However, certain collective trades occur commonly in a larger number of children. These trades usually include behavioral abnormalities in terms of social interaction, delivery speech impediments, recognition difficulties, and expression inability. Hence, simple tasks that are essential for learning, such as following instructions, focusing on an activity, and attention spans, are extremely challenging for children with ASD, resulting in learning difficulties.

The conventional therapeutic methods include pictorial tools, e.g. cards, flip charts, posters, etc. The research community has also been active in using a variety of different electronic tools and toys, e.g., tablet PCs, mobile phone apps, and computer games, etc. The underlying objectives of the studies conducted using these tools is to improve focus, hand-eye coordination and memory retention in children with ASD. During past 5 years, several articles have been published to report experimentation with toys with smarter interfaces and robots. Compared to gaming applications in PCs, robots are

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