Chapter 1

Social Robots for Pedagogical Rehabilitation: Trends and Novel Modeling Principles

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ABSTRACT

The use of robots as educational learning tools is quite extensive worldwide, yet it is rather limited in special education. In particular, the use of robots in the field of special education is under skepticism since robots are frequently believed to be expensive with limited capacity. The latter may change with the advent of social robots, which can be used in special education as affordable tools for delivering sophisticated stimuli to children with learning difficulties also due to preexisting conditions. Pilot studies occasionally demonstrate the effectiveness of social robots in specific domains. This chapter overviews the engagement of social robots in special education including the authors’ preliminary work in this field; moreover, it discusses their proposal for potential future extensions involving more autonomous (i.e., intelligent) social robots as well as feedback from human brain signals.

INTRODUCTION

A percentage around 4% of the students in member countries of the European Union (EU) are registered in special education programs according to Special Needs Education (2012) European data. At least 10% has been reported in the USA regarding children characterized by a learning difficulty (Cortiella, & Horowitz, 2014), while in Finland a reported 17% of students are enrolled in special education (Meijer, Soriano, & Watkins, 2003). Special scientists such as educators, pedagogues, psychologists and speech therapists suggest that the percentage of children in need for special education is higher than reported, since many cases are not recorded for various reasons (Pastor, & Reuben, 2008). Furthermore, if we also consider the families of children then the percentage of people involved in special education is even higher.
higher. For the aforementioned reasons, the support of children with Special Education Needs (SEN) is included in national/European/world policies (UNESCO, 1994). Children with SEN are experiencing a variety of difficulties in family as well as at school. Effective special education at an early stage may improve the emotional and social development of children with SEN, their learning capacity, and, finally, improve the quality of life for a significant part of the population. Furthermore, special education may also improve the work skills of people with SEN thus enhancing a nation’s workforce. There is a need for a policy framework regarding SEN. The latter has been a subject of debate in particular regarding whether special education itself is a problem of, or the solution to, issues of social justice (Norwich, 2007).

During the last decades robots seem to leave the industrial manufacturing floor and enter other domains such as farming, surveillance, entertainment, education, etc. Educational robotics are used worldwide as learning tools (Miller, Church, & Trexler, 2000) but surprisingly rarely in special education. At the moment, the demand for special education services remains high, yet unsatisfied due to the high cost involved. However, the benefits surpass all costs. Lately, Cyber-Physical Systems (CPSs), including social robots, have been proposed in education with emphasis on special education (CybSPEED, 2017). Note that the concept of CPSs has been introduced to account for technical devices with both sensing and reasoning abilities including a varying degree of autonomous behavior. There are a lot of expectations from CPSs (Serpanos, 2018). Seven types of CPSs are most often discussed, focusing on Disabled People, Healthcare, Agriculture and Food Supply, Manufacturing, Energy and Critical Infrastructures, Transport and Logistics, and Community Security and Safety. To them one additional type has been proposed lately, namely Education & Pedagogical Rehabilitation (CybSPEED, 2017). The CPSs we are interested in here include Social Robots in (special) education such as NAO, Pepper, Jibo, Leka etc. (Papakostas et al., 2018; Ueyama, 2015). In particular, humanoid robots such as NAO are already employed in various contexts for the treatment of children with Autism Spectrum Disorder (ASD) (Amanatiadis et al., 2017; Kaburlasos et al., 2018 January; Lytridis et al., 2018; Ueyama, 2015).

Despite reported evidence, the majority of people are still skeptical regarding the application of robots in Special Treatment and Education (STE) of children. For example, according to a recent survey (Eurobarometer, 2012), European responders appear positive towards robots but 60% of them believe that robots should be banned from taking care of children, the elderly as well as the disabled. Furthermore, only 3% said that robots should be a priority in education, while 34% maintained that robots should be banned from education altogether. All the aforementioned responses were attributed to the people’s belief that robots may be dangerous for certain, sensitive categories of people. A more recent survey conducted simultaneously in three Balkan countries (Kostova et al., 2018) has confirmed the aforementioned results, and furthermore it recorded responses encouraging the joint engagement of robots and information technologies. An important question is posed next.

How far can a social robot interact with a child without raising ethical questions? General public opinion is important toward answering the latter question. Note that studies based on public surveys regarding the use of robots in eldercare revealed high acceptance of pet-like therapeutic robots, for humanoid caretaker robots as well as for surveillance care robots (Moon, Danielson, & Van der Loos, 2012). However, rejection of robots is reported occasionally because people often think that robots might replace humans and take their jobs. It seems that negative public opinion is probably the biggest challenge the scientific community must overcome in order to introduce social robots in the field of STE. Adaptation of a robot’s appearance and/or behavior would improve the acceptance of robots by human users (Kanda et al., 2008).
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