Social Robots in Special Education: Current Status and Future Challenges

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Nowadays, we are witnessing the new technological revolution characterized by the participation of a new generation of robots in humans' real life. This type of robots is called "Social Robots" and aims to help humans in their everyday activities. A socially sensitive and high demanding application field of these robots is the education of children having a variety of disorders e.g. autism spectral disorders. This work reviews the past approaches of child-robot interaction for educational purposes, by highlighting the progress achieved up to now and summarizes the specific challenges that need to be addressed in the near future.

***Key Words*:** Social Robots, Special Education, Human-Robot Interaction.

1. Introduction

In a world that changes continuously and rapidly, the role of education for children is significant towards developing active citizens as members of the modern societies. Moreover, every country is obligated to provide education to their citizens and each citizen has the right to be educated.

Although, the abovementioned statements are constitutionally guaranteed, the way the education is provided and/or its effectiveness is not always well defined and ensured. The whole situation is more complicated and floating, in the case of the education of children with special needs, which constitute a small but not negligible part of children's population.

Recently, there is an increased interest in applying technological tools in the educational process, such as mobile devices [1], ICT [2], robots [3], etc. The later tools have proved to be very useful for the education of the children especially those children characterized by specific learning disabilities. Recent works have shown that robots can help children with special needs to reach their learning goals and connect with the world [4].

This work presents a focused review on the impairment cases where social robots are applied and the corresponding challenges in each case that need to be addressed in order to improve the educational process.

The paper is organized as follows: A literature analysis of the last decade is presented in Section 2. Section 3 discusses the current status of applying social robots in education, while Section 4 highlights the challenges that are still open and need further investigation. Finally, Section 5 concludes the paper.

2. Literature Analysis

The continuous technological progress in the last years has emerged the application of robotic devices in the everyday life of humans. We call these robots "Social Robots" in order to describe not only an assistive interaction between humans and robots, but also the establishment of a social interaction that aims to improve the social profile of humans. Here we are interested for the social robots interacting with children having learning disabilities, during the educational process.

In order to better understand the influence of robotic devices in special education, we conducted an in depth analysis of the literature of the last decade. The analysis was performed by using the Scopus [5] dataset of peer-reviewed literature with the search keywords and the rule - *"human-robot interaction" AND "special education" OR "special needs education" OR disorder OR autism* -. The results of this analysis are illustrated in Fig.1.

The conducted literature analysis reveals the increased interest in involving social robots to the education of children with special needs over the last ten years. This outcome testifies the following very important facts:

1. There is a significant progress in the development of more suitable social robots in terms of accuracy, effectiveness and social adaptability.
2. There is an increased acceptance of the social robots as useful tool in education, by the professionals and the parents of the children as well.

Although, there is a significant progress of engaging social robots with impaired children, several technical and ethical issues [6] need to be addressed in the future.

3. Current Status

As far as the current status, regarding the types of children's impairments/learning disabilities engaged with social robots, 125 from the total of 175, identified in the Scopus database, publications were studied and analysed.

The majority of the research in special education involving social robots was applied for the following children impairments:

1. Autism Spectrum Disorders (ASD) [7].

2. Attention Deficit Hyperactivity Disorder (ADHD) [8].
3. Cognitive impairments [9].
4. Motor impairments [10].
5. Mental impairments [11].
6. Communication impairments [12].
7. Developmental disabilities [13].
8. Hearing impairments [14].

In almost all the cases an anthropomorphic robot bought directly from the market, was used as an interaction with the children tool or as a teaching assistance. The age of the children varies between 2-13 years old, although some experiments were conducted with children up to 20 years old. The interaction between robot and child mainly is established via a specific educational game.

In general, children feel more comfortable interacting with robots than humans, since the robots looks like toys having human-like communication abilities and they do not criticize, judge, or punish them.

4. Future Challenges

Despite the effective children engagement with social robots in special education, there are specific challenges in improving the interaction experience and in extending the engagement in more complex educational scenarios and configurations.

More precisely, some of the most challenging issues needing future investigation are:

1. Finding scenarios for gaining the attention of someone with ASD.
2. Encouraging verbal communication during interaction.
3. Developing interaction quality assessment measures.
4. Dynamically adjusted scenarios by considering a close control loop between robot and child.
5. Developing of multi-robot and multi-child interaction scenarios.

It is worth to note that the abovementioned challenges deal with the improvement of the overall child-robot interaction as a communication protocol. However, these challenges can be realized with the overcoming of some technical limitations/deficiencies regarding the recognition algorithms, robot hardware/architecture, robot appearance, etc.

5. Conclusions

This work highlights the importance of social robots in special education, from a quantitative and qualitative point of view, as well. The current study is focused on the relation of social robots and children's impairments, in order to analyse the robots' applicability.

The overall analysis is concluded by defining the challenges in the specific research field, towards the establishment of the child-robot interaction as a certified educational tool for promoting special education.

ACKNOWLEDGEMENT

This work has been supported, in part, by the European Commission Horizon 2020 MSCA-RISE Project no. 777720 "Cyber-Physical Systems for PEdagogical Rehabilitation in Special EDucation (CybSPEED)".

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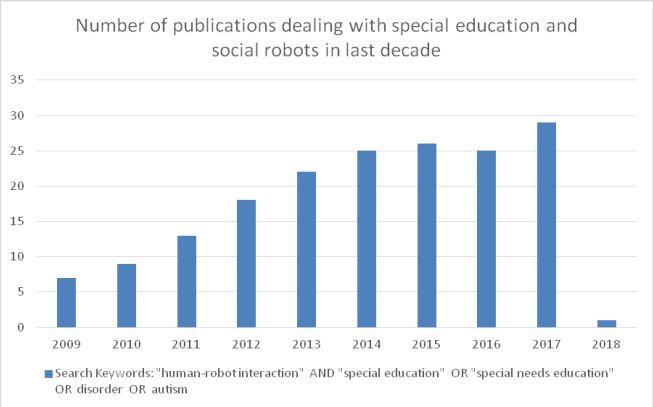

Fig. 1: The proposed framework.