Towards Social Robot-based Inclusive Museum Experiences for Children with ASD

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Abstract
Museums are increasingly taking into account inclusion issues, like for children with ASD, offering inclusive learning. The aim of this perspective paper is to present the outline of the AStRO (Autism-friendly museum experience with Social RObots) project and propose a user-centered approach to designing autism-friendly experiences using a Social Robot as a Museum Guide.

Keywords
social robots, museum experience, ASD children

1. Introduction

Children diagnosed with Autism Spectrum Disorder (ASD) are an important audience for museums. Museum curators try to make museums more inclusive providing ASD children with valuable learning opportunities as for their neurotypical peers. To this aim, they recognize the diverse learning needs of children with ASD, implement specific educational strategies, provide additional resources, and adapt the environment accordingly to guidelines for people with impairment of cognitive functions [1].

To better support children with ASD, museums have introduced several initiatives such as sensory kits, predefined visit hours, special accessibility events, and staff training on disability awareness. These efforts aim to improve the museum experience for individuals with ASD and to make cultural institutions more friendly for all visitors.

In recent years, Social Assistive Robots (SARs) have emerged as promising tools to address the needs of children with ASD [2]. Interventions utilizing SARs have shown positive outcomes in improving various areas, including joint attention, social communication, imitation, and social behaviors [3, 4, 5].

In this perspective paper, we present our research project AStRO (Autism-friendly museum experience with Social RObots) which aims at using a social robot as a museum guide to provide ASD visitors with an inclusive experience during the visit. As a robotic platform, we will use Pepper, a semi-humanoid robot developed by SoftBank Robotics [6]. It is an omnidirectional wheeled humanoid robot equipped with several cameras and sensors. As far as the Museum is concerned, in this first phase of the project, we will focus the application on the "Museo dell'Informatica" of the University of Bari which is hosted in our Department. Recently, a lot of schools have visited the museum and, in some classes, there were ASD children very interested in the items shown in the museum, however, we observed that for them following the tour and listening to the group explanation of the human guide was too challenging or not engaging. In [7] a study conducted at the Canada Science and Technology Museum showed that, to provide an inclusive experience for ASD people it is important to reduce sensory stimulation, improve navigation resources, create interactive exhibits and provide more support persons.

In the AStRO project, we aim at answering to the following Research Question (RQ): How can a Social Robot provide a better experience for ASD children during a Museum visit?

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Figure 1: An example of Pepper guiding visitors (left) and describing items (right)

To answer this question we defined the design steps and the variables we want to assess in the final user study.

2. Outline of the design process

The first phase of the project will consist of the co-creation of the visiting experience. From a methodological standpoint, co-design is important for developing products and solutions that are acceptable. Co-design, then, acts as a tool for neurotypical people to understand and share the perspectives and communication styles of ASD individuals, and vice versa. Employing a co-design approach, in which ASD children are involved since the beginning, will allow the integration of their knowledge and needs into the design process [8]. Accordingly, the design process will be centered on understanding these needs, integrating them into the design, and obtaining iterative feedback on the developed prototypes or products. To do so 5 ASD children from mild to moderate levels of severity (DSM-5 [9]) attending secondary school will be included in the user-centered design of the AStRO application. The children will be accompanied by their support person.

To avoid the blank page effect, researchers will design the first prototype by following guidelines for museum accessibility for cognitive visitors [1] and educational strategies for ASD children (i.e. [10, 11]). The content presentation of elements that will be explained in the visit will be customized for children with ASD. The content creation phase, presentation modalities' design, and social robot behaviors will be conducted and supervised by experts in education of people with special needs and the museum curators [12].

For instance, sentences will be short, the robot's voice will be supported by content on the robot's tablet, button will be provided to go on, repeat and ask questions to the robot. To direct the attention of the child the robot will indicate the piece of the exposition to look at, if items included in the visit are touchable, the robot will invite the child to do this experience and so on.

At the end of each museum section, some simple games will be provided by Pepper (on its tablet) to motivate the children and, at the same time, to assess their attention and learning of some of the concepts illustrated by the robot during the visit.

The AStRO application will be developed as a special use-case of the Pepper4Museum one [13]. In this application, Pepper can guide the visitor on a tour (Figure1 - left) or provide the visitor with explanations about items of interest of the user during the visit (Figure1 - right).

During the various phases of the iterative user-centerd design, formative usability and UX tests will be performed. Their results will give us the possibility to refine the design of the AStRO application so as to provide the best experience possible to ASD children in a Museum.

At the end, a user-study will be conducted to measure some variables that will allow us to answer our RQ. The approval of the Ethic committee of the Forpsicom department will ensure that the research is conducted ethically and responsibly, respecting the rights, welfare, and safety of the children involved. It will also ensure that the parents or guardians of the children have given their informed consent, fully understanding the purpose and process of the research, and that appropriate measures are taken to protect the privacy of data collected during the research.

In the study, five ASD children, different from those involved in the design phase, but comparable in terms of severity and age, will be involved. After receiving instructions on the visit modality, each of them will be asked, together with his support person, to visit the exhibition. From observing the behavior of the children[14], we will define some metrics based for instance on:

- Time: how much the child followed the robot during the visit, - Engagement: with the robot during the visit, - Followed robot's request: how many times they looked at the item when the robot indicated it. - Acquired knowledge: tested through games - Desire to repeat the experience.

In addition, a questionnaire will be created to acquire information about the experience from the support person's point of view.

The same procedure will be used with a control group of ASD children who make the same tour but with a human guide in order to compare results.

3. Conclusions

This perspective paper aims to present a project, AStRo, that has the main aim to design and develop an inclusive museum visit for ASD children by exploring the potential of Social Robots. The approach will be based on user-centered design in which ASD children will collaborate with the design team in creating the final application. Co-design allows us to have a better understanding of ASD children's needs and expectations. It's important to note that ASD is a spectrum disorder, and individuals can have a wide range of abilities and challenges within each level. This may require personalization of the presented content and the robot's behavior. The developed solution will be tested to gain insight and understand if, including a social robot as a part of the museum visit leads to a more positive and engaging experience for ASD children.

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