Learning and Teaching Biodiversity Through a Storyteller Robot

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Abstract. This research project proposes the use of Child-Robot Interaction principles to boost the interest and engagement of young children in the biodiversity curriculum. We propose an architecture where a robot learns from children through an Interactive Story, while at the same time teaches them previous knowledge acquired in past interactions.

Keywords: Child-robot interaction · Interactive Storytelling · Learning · Teaching · Biodiversity

1 Introduction

People are used to seeing robots as machines that are programmed to perform precise instructions and/or tasks to help us, but in the last years, this role has been changing. More recently the new trend is to have robots receiving help from us to perform their tasks, to learn, and to become more autonomous. This concept is helpful since it can promote spontaneous "learning by teaching" outcomes, especially regarding children [5].

However, children can act in a very unpredictable way—especially young children. So how can we make robots maintain a social bond with them? The work of Belpaeme et al. [1] suggests that children respond better to robots that adapt their behaviour to them. The author also claim that physically embodied agents, such as robots, receive more attention than virtual agents, leading to promising results for education and social interaction.

Nowadays different approaches have been used in education to improve learning literacy and storytelling is a promising one [6]. The use of Interactive Storytelling (IS) has the benefit of supporting children in expanding their creativity, developing their perception of sensations and situations [3,4]. This is possible because, unlike a non-interactive story, IS allows them to be part of the narrative, inclusively influencing the children to make certain decisions at some

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points. A good example is the work of Kory and Breazeal [2], where children interact with a social robot who is telling them a story. The companion robot used was designed to behave in one of two different ways. In one condition, the robot has a reduced vocabulary, while in the other condition the robot exhibits an increasing performance over time (evidenced through changes in its speech, behaviour and vocabulary). The authors state that children that interacted with the robot in the second condition maintained or increased the number of learned words and language diversity when compared with the children who interacted with the robot in the first condition.

The main goals of our research are multi-folded. On one hand, we aim to leverage Child-Robot Interaction (CRI) in order to increase children awareness and a basic understanding of basic Artificial Intelligence (AI) and Human-Robot Interaction (HRI) principles. On a different level, we aim to better understand how to improve children-robot interaction and build new relational models based on the learning by teaching paradigm, for both the child and the robot. Finally, as a specific output of this project, we evaluate the possibility of engaging young children with specific scientific subjects through HRI.

2 Methodology

As previously mentioned, in order to reach our research goals we propose exploring child-robot interaction in a storytelling context, where the robot plays a special part in the story. By maintaining a rich dialogue with the child, the robot will support the learning by teaching paradigm, on which the project rests. In this section, we describe a possible scenario of interaction and briefly discuss an architecture for the system, the interaction protocol, and possible deployment.

2.1 Integrating Storytelling with HRI

The interaction between child and robot will be driven by a narrative that will frame their encounters. In it, the robot acts as an alien recently arrived on Earth that is interested in learning about this new environment, for which it enrols the children's help. Children are asked to answer simple scientific questions (for example, "*Is this an endemic plant of the island or not?*"), interact with the robot both verbally and through an interactive display placed on the robot, and share local stories that the children may have gathered/know.

The interaction between child and robot in such a "child teaches robot" paradigm will facilitate the collection of local stories in a natural way. Such local stories can then enrich the narrative of the robot in future encounters. Eventually, the robot can re-tell the learned narrative artefacts by referring to the source of the information (for example, the robot can say "*I learned from Luísa that lives in Santana, that ...*"), giving context to the stories that are told.

2.2 Scenario

The teacher introduces *BioRobot* to the classroom, a special robotic guest from outer space who is curious about our nature. The interaction proceeds as the robot asks questions to the children about material previously covered in their school curriculum. The children provide answers as well as personal stories. These stories are conveyed to the robot through its touch screen panel or related to the teacher who, when needed, acts as a mediator between the guest and the children (for example, when the robot cannot understand the child's input). The robot incrementally learns about nature and biodiversity on an island, while the children consolidate their knowledge while engaging in HRI.

Architecture. Figure 1 presents a possible architecture for the system supporting the aforementioned interaction scenario. The IS module is responsible for guiding the learning process of *BioRobot* and the children through a story that relies on knowledge about the flora and fauna of an island. The child teaches *BioRobot* about what he/she knows about the island biodiversity,[1] and the robot teaches the child some past knowledge acquired from another child. Such information is stored in the Stories Database. The Computer Science module is responsible for conveying the child concepts about AI and Robotics through the guidance of a mediator (e.g., a teacher) along the story flow.

Child–Robot Interaction (CRI). We will promote the CRI experience through a specific story to be presented in the classroom environment. Classes of children's,

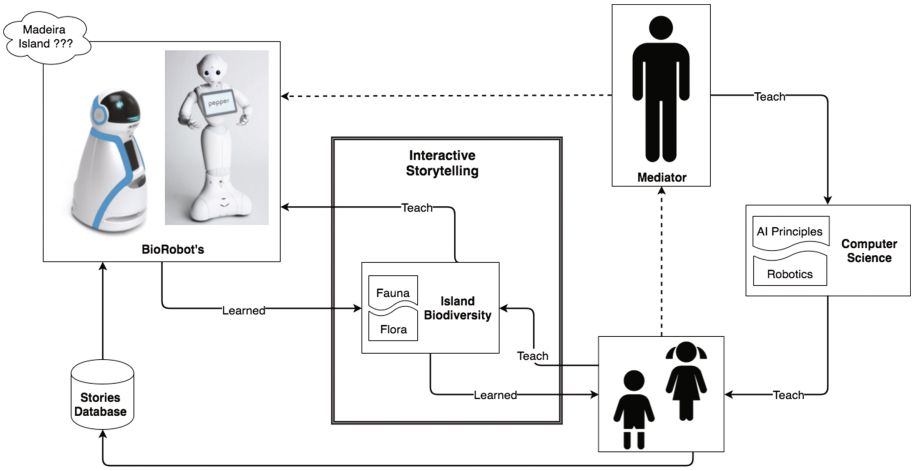

Fig. 1. System architecture.

[1] We note that the architecture can equally be used for similar interactions on other topics, simply replacing the subject of the interaction.

supported by their teacher and researchers will interact with *BioRobot*. By means of Q&A along a story, the robot asks and learns from the children about the scientific aspects of the natural patrimony of the island, while the children will grasp basic concepts of AI and Robotics.

Deployment. Finally, once enough learning has been acquired by the robot, *BioRobot* could be stationed at a local science park and will provide specialised tours for local children, supported by staff and teaching personnel. *BioRobot* will then interact with the public by providing information, stories, images projections as well as asking questions to children visiting the site. A help button and camera could guarantee remote parental or teachers control over the visits.

Ultimately, the *BioRobot* will maintain a web-based relationship with the children. The goal is for children continue to learn about biodiversity, engage with the robot (even if virtually), and also learn to form a social network among themselves. These will be done according to a protocol designed together with the schools involved in the project.

3 Conclusion

In this work, we present the first steps we intend to take in order to promote CRI using an IS scenario. Our main goals will allow us to investigate how can we improve CRI and at the same time build a relationship between the robot and the child that support the learning by teaching paradigm. In future, we intend that the approach followed will increase the young children engagement and at the same time, support the robot to keep learning even after the novelty effect has passed.

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