CASPER Project: Social Pet Robots facilitating tasks in Therapies with Children with ASD

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Abstract— In this paper, we present a Cognitive Assistive Social Pet Robot design and an early field study with it to facilitate learning with children with Autism Spectrum Disorder. The robotic platform is a low-cost robotic turtle based on a RaspberryPI and Arduino.

Keywords— Social Robotics, Pet, Austism, Therapy, Social Skills

1. INTRODUCTION

Through social robots, technology has begun to move from being a science fiction field to research laboratories and even into our society. These are autonomously acting, communicating, learning and self organizing robots which can also use spoken languages and mimic animal characteristics [1]. Animals are embodied, living beings, which creates strong constraints on what they can do and how humans can use them. Humans have always been attracted to animals; they are utilized partly as an outlet for increased social needs [2]. Furthermore, research has supported that animals play an important role in children‘ s healthy development offering comfort and companionship, and promoting the development of moral reciprocity and responsibility [3].

There is a lot of evidence in the literature that pet animals and wellbeing are correlated [4], [5], [6]. We know that the companionship provided by a pet can lead to a better health, mesured by survival rates [7].

Social pet robots are important for children with special needs such as developmental disorders or autism due to their assistive effectiveness. It is well established that people attribute intentions, goals, emotions, and personalities to even the simplest of machines with life-like movement or form [8]. Recently, social pet robots have been introduced to reproduce the social and emotional benefits associated with the interaction and the emotional bond between children and companion animals such as entertainment, relief, support and enjoyment [9].

In this paper we present the first working model of CASPER robot. CASPER, Cognitive Assistive Social PEt Robot, is a robotic platform that aims to improve quality of life of children that are visiting hospitals or have special needs. The design of this robot comes from what we learnt from previous experiences in the PATRICIA project and the social pet robot PLEO rb [10]. The objective is to develop a complete experience supported on added commercial technological tools, like tablets or bracelets, and gamified interventions in order to increase engagement and adherence to the treatment of people involved in the process and to extract information from the interaction to monitor the program and the caring process.

2. THE ROBOTIC PLATFORM

These strategies cover everything from the biologically-inspired to the functionality-based robot design. In this project we aim to conceive a new assistive robotic platform, designed following the functionality-based strategy. In this strategy the robot will be on the table as a helper, social mediator, and logger of whatever that happens during the interaction sessions. Its functionality is based in a behavioural architecture similar to the one proposed in [11]. From a technical point of view the two main constraints in the robot design are the connectivity required for the cloud-based platform, and keeping all elements affordable to achieve a low-cost solution..

The reduced processing power, storage capabilities, and number of sensors included in the current robots prevent them from going beyond their historically static and predefined behaviour [12]. In opposition to what has been achieved in other domains [13], it is still not feasible to codify the knowledge of the expert (i.e. medical staff) inside a single unit in a reliable and cost-efficient way.

In Figure 1 we can see our approach to the core design of the robot. We have divided the electronic controllers into two parts to expand the functionality of processing power: the high-level process unit with a RaspberryPI that is running ROS, and the low-level process unit based on an Arduino that manages all sensors and actuators except for the camera, screen, and microphones.

Regarding the embodiment, we developed a co-participatory design with a group of two hundred children from the Montserrat School of Barcelona, between 9 and 12 years old, who followed a Design Thinking process assisted by our the research team. From that participatory design, we

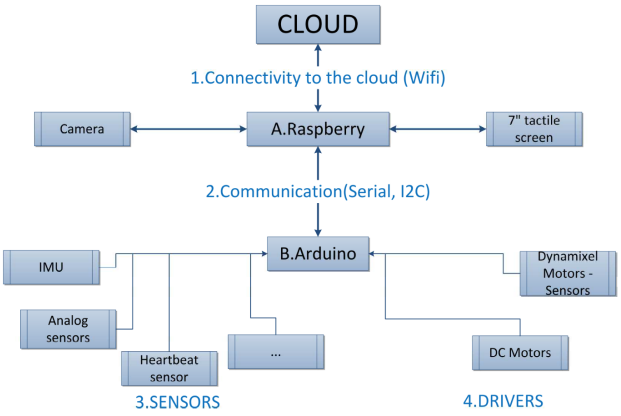

Fig. 1. Tasks in CASPER Project

extracted different types of morphisms for the embodiment, as well as playful functionalities of the robot. From all the possibilities we choose a turtle because it matches all of the characteristics of the real animal and the feasibility of implementation of the prototype.

Taking a look at the most relevant components, the shell provides an easy and safe interface to manipulate the turtle: the screen allows us to design more interactive and assistive activities, as well as non-verbal feedback to the children, and then we added a turnover sensor that triggers the scared mode in case the turtle is placed in up-down position 2.

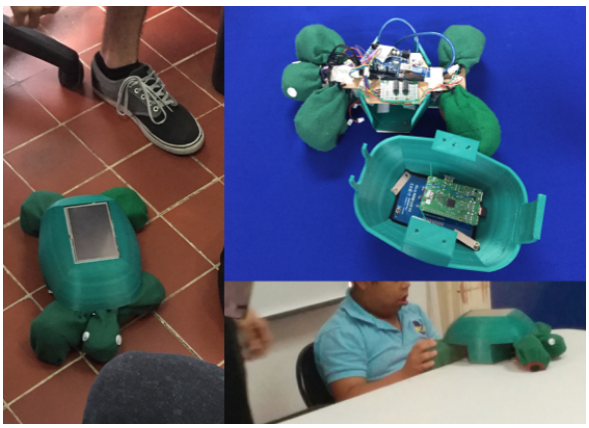

Fig. 2. First full-operative CASPER robot used in Panama with children with ASD

3. THE TEST OF THE ROBOTIC PLATFORM, CONCLUSIONS, AND FUTURE DIRECTIONS

In order to test the robustness of the system in a real environment, we used the robot during eight sessions with children with severe autism in the center CASPAN from Panama. In these sessions we used CASPER robot together with a Pleo rb robot and a LEGO-based dog-shaped robot. The robots were used in two different ways: 1) as the main agent during the session (count how many legs the robot has, what colors we can find in the robot, etc.); and 2) The robot was also used as a rewarding system (if you succeed with doing the activity you will be able to play with the robot). A total of twelve children played with CASPER.

In future work, we are going to present the data analysis of the comparison between the three platforms used in this study. But for CASPER, we observed that the platform was very well accepted by the children (none of them rejected to play with it), the platform was more robust that the LEGO-based dog, and, because of the screen, more playful that the Pleo rb. In addition, the processing power and the connectivity is higly improved because of the technology used.

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