IEEE RAS-SIGHT Final Report

Humanoid robots for therapeutic treatment of Autism Spectrum Disorder (ASD) children

Background

Current clinical practice in the treatment of children with ASD calls for behavioural treatment in order to improve social, communication and cognitive skills of children. The goal is not only to minimize the main symptoms but also reduce the risk of secondary symptoms such as aggressiveness and irritability. Intervention programs based on behaviour combine development and education methods. But children have difficulties in their relationship with therapists.

Previous work to mitigate this problem has been done using animals (dogs, horses, dolphins...) with good results, but working with animals is very complex.

Therapists in hospitals have identified a need, as these children need special care, and a possible solution: several non traditional health treatment alternatives (using animals, machines and robots) have shown marked improvements in the children life quality.

Methodology

It is known that ASD children seem to be motivated by technology, and some treatments using dolls and marionettes have shown good results with some patients. Thus, we decided to explore the use of humanoid robots in the treatments.

This project aims to enhance existing therapies using interactive humanoid robots, to increase the effectiveness of treatment and the transfer of skills to everyday life environments, allowing better control of the variability of the stage, and more repetitions during therapy.

The robot complements the use of other devices such as phones or tablets, adding a physical dimension of the real world, with movement and interaction, which leverages technology to stimulate the child's behaviour towards social relationship.

We could list several reasons for the effectiveness of the use of robots in children with ASD:

1. Robots are attractive and encourage children with ASD to interact.
2. The behaviour of the robot is consistent and very predictable, something very desirable.
3. Children with ASD have difficulty paying attention to multiple stimuli for social interaction. Robots provide fewer stimuli, and they are able to adapt the complexity of their behaviour.
4. The robots allow simple and predictable social interaction, reducing stress and pressure in the children. Accordingly, the treatment may be most satisfactory and effective.

Development of the project

The Robotic Intelligence Laboratory (http://robinlab.uji.es) organized a multidisciplinary work group with two hospitals, through FISABIO (Foundation for the Promotion of Health and Biomedical Research of Valencia), and signed a collaboration agreements with Manises Hospital (http://www.hospitalmanises.es) and La Ribera Hospital (http://www.hospital-ribera.com) both in Valencia, Spain. The aim was to develop a project to provide treatment to ASD children using NAO robots.

During year 2016, one NAO robot has been deployed by RobinLab into each hospital, with the developed application for assisted therapy in children with ASD. The project team consisted of faculty and staff from Robotics group, including students from the Master in Intelligent Systems and the PhD Program in Computer Science, and medical and therapeutic staff from the hospitals, who advised on the development of the application.

The application has been tested on children aged between 4 and 7 years, who have received weekly therapy sessions with robots at the Unit of Child Neuro-rehabilitation Hospital Manises (UNRHI) and the Institute for Diagnostic and Research Children with Autism Spectrum (IDINEA) associated with the Hospital de la Ribera.

As a result of the project, an application for humanoid robots based on mobile platforms has been obtained and tested in children in therapy. After the end of the project, the two humanoid robots will be available to the collaborating institutions, and the application and associated documentation will be accessible in a repository https://sites.google.com/a/uji.es/robots-for-autism/

The application is open, and free so it can be used by associations, hospitals and organizations throughout the world. And we believe that the application is also easily customizable, so that a therapist without specific programming skills will be able to adapt it to the needs.

To enjoy the full benefits of the application, tablets and robots need to be acquired by other interested institutions, to employ in the therapy of assigned children. Although the robot chosen for this project allows the development of applications in the most common operating systems on the market (Windows, Linux or Mac OSX), the design of the application is open and easy to adapt to other robotic platforms available in the market.

Budget

The project was partially sponsored by IEEE RAS-SIGHT with $2500 for year 2016. Additional funding was provided by Jaume-I University and La Ribera Hospital. Funding from RAS-SIGHT was specifically used for these items:

- Robot maintenance and battery replacement: the NAO robots used in the experiments had to be checked, and some joint motors needed repairing, and their batteries replaced, for a total amount of approximately $1,600.
- Acquisition and evaluation of an affordable robot platform: we seeked for alternative robot platforms, with lower economical cost. The acquisition of a Robotis Mini and other materials was partially funded with $400.
- Travel to IROS 2016: the principal investigator of the project attended the IROS 2016 Conference, where a meeting of RAS-SIGHT was held, for presenting the project. This travel was partially funded with $500.

Final remarks

This project has developed and tested a robotic application that can be used by therapists in standard treatment sessions with autistic children. Using the application does not require programming knowledge, and maintenance is simplified to the maximum.

The developed application allows to offer a complete hardware-software solution to hospitals and care units. The product is aimed at professionals in the autism therapy, both nationally and internationally.

We gratefully acknowledge the support of IEEE RAS-SIGHT for this project, and believe that it has significantly contributed to its success.

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