Mobile Robotic Toys for Autistic Children

François Michaud, Pierre Lepage, Jean-Daniel Leroux,
Matthew Clarke, François Bélanger, Yannick Brosseau and David Neveu
Department of Electrical and Computer Engineering
Université de Sherbrooke, Sherbrooke (Québec Canada) J1K 2R1
michaudf@gel.usherb.ca, http://www.gel.usherb.ca/crj

Abstract

Autistic people seems to be living in their own closed world, being usually very resistant to interaction and communication. The paper reports experiments conducted with different mobile robots to see if such devices can help autistic children open up to their surroundings and develop social skills.

Keywords: Mobile robots, new applications of robotic technologies, educational and remedial tool.

1 Introduction

To get Electrical and Computer Engineering (ECE) undergraduate students to apply and integrate their knowledge in these disciplines, our department uses in different courses a small mobile robotic platform called ROBUS. Using this platform, we also want them to acquire teamwork experiences and be placed as close as possible to the reality of the engineering profession, working on projects having social implication. In that regard, we have initiated in 1998 a project where students are asked to design a mobile robotic toy to be used by children with learning and physical disorders, more specifically autistic children [2]. Based on the idea of having a robot moves and generate interesting behaviors, the goal is to see if interacting with robots could help autistic children increase their ability to focus their attention and to be more opened to their surroundings. This short paper presents the underlying goals and the results of a first phase of experiments using four different robotic toys with autistic children or children with learning disorders similar to autism.

2 Mobile Robotics and Autism

Autism is characterized by abnormalities in the development of social relationships and communication skills, as well as the presence of marked obsessive and repetitive behavior. Also associated with learning difficulties, autism is considered to be one of the most severe of the developmental disorders. All people with autism have impairments in social interaction (difficulty with social relationships, for example appearing aloof and indifferent to other people), social communication (difficulty with verbal and non-verbal communication, for example not really understanding the meaning of gestures, facial expressions or tone of voice) and imagination (difficulty in the development of play and imagination, for example having a limited range of imaginative activities, possibly copied and pursued rigidly and repetitively). In addition, repetitive behavior patterns are a notable feature, as for resistance to change in routine. Despite several decades of research, relatively little is understood about the causes of autism and there is currently no cure for the condition. However education, care and therapeutic approaches can help people with autism maximize their potential, even though impairments in social and communication skills may persist throughout life.

The fundamental goal of this project is to see how mobile robots could help autistic children open up to their surroundings, improve their imagination and try to break repetitive patterns. But first, we needed to see if a mobile robot can get the attention of an autistic child, and how: is it by its movements, by its appearance, by having moving parts, by musical or speech interactions, etc.? To explore these different aspects, teams of ECE students elaborated their design specifications using profiles of children diagnose with autism or other learning disorders similar to autism, and using information about the TEACCH program (Treatment and Education of Autistic and Related Communications Handicapped Children). It was up to the students to add sensors, actuators and to develop the capabilities they believe to be appropriate for the robot. They also had at their disposal a voice recording and playback device to generate short vocal commands. Figure 1 shows the four robots used in the experiments conducted with autistic children, each robot offering different ways of interacting with

Figure 1: SuperG, Cari, Robus-T, DiskCat (from left to right, top to bottom).

the child. SuperG has a moving tail and vibrates when you hold it. Cari offers different games (like dancing and shape identification) involving geometrical shaped and colored push buttons. Robus-T uses a heat sensor to follow people, while DiskCat emulates a cat using bed sensors as whiskers. All used the speech interface and music in their interactions with the child.

In the experiments, the robots were presented one by one to each child in a 15'x15' room. Each child had his or her own distinct way of interacting with the robots. Some remained seated on the floor, looking at the robot and touching it when it came close to them. Others moved around the robots, sometime showing signs of excitation. One really liked the dog-shaped robot, probably because he had a dog at home. But the most interesting observation made was when one child started to follow the walls of the room (as she usually does), and interplay with DiskCat for short amount of times as she went. Eventually, the robot moved away from the walls and she slowly started to stop (first at one particular corner of the room, and then at two different places) and look at the robot moving around. At one point, she took the robot by its tale and brought it back to the center of the room where she believed the robot should be. She even smiled and made eye contact with some of us, something that she did not do with strangers. While it may be difficult to generalize the results of this first experiment, we can say that the robots surely caught the attention of the children. What needs to be done now is to analyze what are features help get the attention of the child, and do experiments over longer periods and in normal activities to see how the children interact with the robots pass the familiarization stage. The robots also need to be refined (with learning and adaptation mechanisms) and made more robust to eventually converge on a complete robotic toy for autistic children.

3 Related Works and Conclusion

We recently found out that Dautenhahn [1, 3] of the University of Reading in England has also recognized the usefulness of using mobile robots as aids for the rehabilitation of autistic children. She started a project called AuRoRA (Autonomous Robotic platform as a Remedial tool for children with Autism). Initial research and observations were made using a Labo-1 mobile platform from Applied AI Systems (equipped with infrared sensors and a single positional heat sensor), programmed to do simple forward and backwards movements and a following behavior. Some of her conclusions are that it will be necessary to increase the scope of sensors available on the robot to allow a greater variety of inputs and, in turn, lead to more varied interactions. Also, a moderated speech interface is recommended, as for a flexible environment to better adapt to the individuality of each autistic child. Our experiments address these recommendations by using different robots with various sensing, actuating and interaction capabilities. In future work, we plan to coordinate our efforts to learn more about how mobile robots can make useful contributions to treat autism.

Acknowledgments

The authors want to thank M.-J. Gagnon, J. Rioux, the children, l'Ecole Du Touret of Rock-Forest, Québec, M. Lucas and the teams of students involved in the design of the robots used for these experiments. F. Michaud is the principal investigator of LABORIUS, supported by NSERC, CFI and FCAR.

References

[1] K. Dautenhahn. Robots as social actors: Aurora and the case of autism. In *Proc. Int. Cognitive Technology Conf.*, San Francisco, August 1999.

[2] F.Michaud, A. Clavet, G. Lachiver, M. Lucas. Designing toy robots to help autistic children - An open design project for ECE education. In *Proc. ASEE*, 2000.

[3] I. Werry and K. Dautenhahn. Applying robot technology to the rehabilitation of autistic children. In *Proc. Int. Symp. on Intelligent Robotic Systems*, 1999.