Engagement based on a Customization of an iPod-LEGO Robot for a Long-term Interaction for an Educational Purpose

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ABSTRACT
The aims of the study presented in this paper are to find evidence that the customization of a robot increases the engagement interacting with it, and the adaptation of a non-social robotic platform like LEGO Robotics is possible. The study has been done with 7 years old children from primary school level that have been doing daily homework activities conducted by the robot during one month. Results showed us a higher interaction and adaptability to a social robot with the customization.

Categories and Subject Descriptors
I.2.9 [**Robotics**] : Commercial robots and applications. D.2.2. [**Design Tools and Techniques**]: User interfaces. H.1.2 [**User/Machine Systems**] : Human factors, Human information processing.

General Terms
Management, Measurement, Documentation, Performance, Design, Reliability, Experimentation, Human Factors, and Verification.

Keywords
Robotics, Robot, Children, Engagement, Long-term, LEGO, and Education.

1. INTRODUCTION
Academic homework has changed in the past years. From being done on a piece of paper, it has evolved to on-line platforms like Moodle. These platforms allow continuous contact between the students and the educators; sometimes providing useful tools that help with routine tasks like correcting tests or collecting deliverables. The idea of this study is part of a bigger project called Robotics@School that pretends to introduce the wide spectrum of robotics inside the schools, from kindergarten to high school levels. In an educational environment robots are mainly used only to teach technology and science, and rarely used for other tasks.

HRI'14, March 3-6 2014, Bielefeld, Germany
ACM 978-1-4503-2658-2/14/03.
http://dx.doi.org/10.1145/2559636.2563697

This paper shows the results obtained in terms of engagement using an iPod-LEGO robotic-based platform to analyze the customized robot's role in terms of engagement and likeness.

In [1] we introduced the LEGO Robotics Platform (See Figure 1) to conduct a robotic therapy for children with traumatic brain damage at home. The results obtained in terms of acceptance of the platform were very encouraging so we decided to use the same platform in an educational environment, with the same purpose as the previous task, to improve cognitive skills of primary school children without special needs.

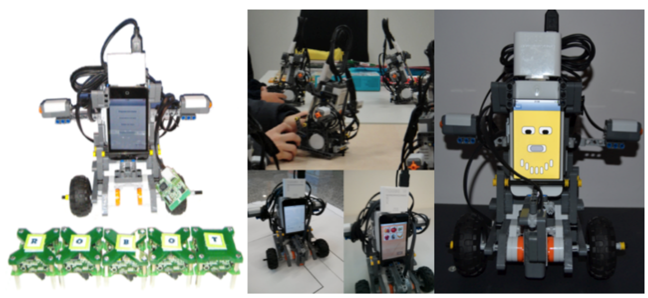

Figure 1. Robot Structure and Appearance

2. iPOD-LEGO ROBOT
2.1 Previous study
Before deciding to use this platform, we performed a study with 94 children of one hour play-based interaction with different kinds of robots: Pleo, Furby, Keepon and a walking robot made of LEGO. After these sessions the children did an exercise on adding (selecting) three adjectives from 20 options [2]. We concluded based on the kid's answers, considering the LEGO Robot as WELL DESIGNED (36.3%) and USEFUL (36.3%), while the Pleo as FUNNY (48.3%) and LOVING (55.2%), and the Furby as FUNNY (42.9%) and LOVING (52.4%). The Furby also was considered INTELLIGENT (42.9%) because it was able to communicate with a smartphone or tablet. The KEEPON was labeled as FUNNY (33.3%), SIMPLE (42.9%) and STUPID (38.1%). So considering all those outputs, we decided to use the same platform used by the project in [1] expecting it to be USEFUL, FUNNY and LOVING.

2.2 Robot Description
The robot's main CPU is an iPod Touch 4G with a software structure composed of three main blocks: 1) The Pet Behavior module that decides the mood and physical state of the robot, 2) The Monitor module that collects all interaction data and the

activities scores, and 3) The Trainer module, composed of the activity dispatcher, the connectivity module, and the activities controller. The secondary CPU is a LEGO Brick CPU that manages the movements of the robot. In [1] more detailed information can be found.

2.3 Activities Description

The activities conducted by the robot can be classified in two sets, the social and the academic. In the social set the child trains his habits, communication, and caring skills, while in the academic set the robot proposes math, language, problem solving, and memory exercises. The interaction in each exercise differs from touching the screen, using sensors (touch sensor, microphone, camera, etc.), and moving the robot as a haptic device.

3. STUDY DESIGN

We did the study with a group of 14 children, all of them with the same platform, but seven of them had a customized robot with their topics of interest collected from a questionnaire filled in by the parents, which asked about hobbies, language preference (Spanish or Catalan), music, etc.

The students received a training session about using the robot, as well as a short manual about how to proceed to start and stop the robot, and to solve the common unexpected issues that could occur. This process took one week where they did the exercises together with a technician. The weeks 2, 3 and 4 they did the activities at home. Every Monday the Technician and the Teacher set up the weekly activities. Finally, the children filled in a questionnaire about how much they liked the robot [2].

4. RESULTS AND CONCLUSIONS

As we expected, in the exercise on adding (selecting) three adjectives mentioned in section 2, the iPod-LEGO Robot was labeled as FUNNY (71.4%) and LOVING (57.1%) as the top adjectives in the customized robots, while USEFUL (42.8%) and INTELLIGENT (57.1%) were the top adjectives in the not customized ones. This shows us that the adjectives in the customized robot are nearer to social robotics rather than the adjectives for the not customized one, which are nearer to a robot seen like a machine. So as a conclusion, customization allows us to convert our Educational Robot to a Social Robot.

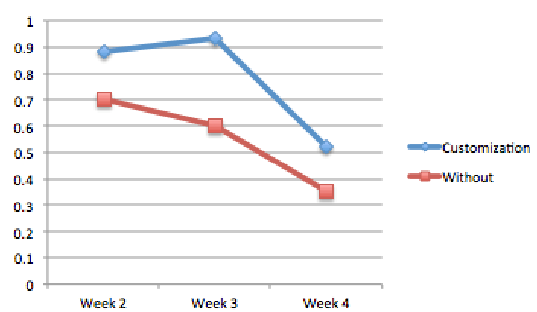

Figure 2. Engagement interaction with the robot measured as normalized use of days versus weeks

Also, analyzing the information from the robot we can conclude that in a long-term interaction, defined as the minimum time required to be familiarized with the robot [3], it is very useful to know the children's preferences in order to keep the engagement (see Figure 2). We also planned the maintenance of the engagement to avoid the deterioration over time [4] with small tricks like greetings and farewells before and after the activities [5], and telling secrets to create complicity between the kid and the robot [6].

Unfortunately, in the last week there was a software bug that blocked the robot during an activity process so the engagement decreased. Despite this bug, if we take a look in Figure 2 we can see the interaction always higher in the customized robot.

We put time stamps to measure the interaction period every day with the robot, however several times the children forgot to switch off the robot. For future studies we will put an automatic switch off function after a period of time without interaction.

We have validated that the design of the robot matches the crossed requirements between the more social robots like Pleo or Furby, and more educational robots like LEGO Robotics platform.

5. ACKNOWLEDGMENTS

Our thanks to Col·legi Montserrat from Barcelona to provide the optimal conditions to conduct the study. This project with code 502858 is founded by La Fundació de la Marató de TV3, and LEGO Foundation donated the robots.

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