Designing Playful HRI.

Acceptability of Robots in Everyday Life through Play.

Maria Luce Lupetti
DAD - Department of Architecture and Design
Politecnico di Torino
Turin, Italy
maria.lupetti@polito.it

***Abstract*— The spread of edutainment robotics in everyday life raises new opportunities that can lead to a redefinition of the traditional game scenarios. Robots, indeed, represents a challenge for designer since allows a physical embodiment of a game character/element. These new opportunities have been analyzed in parallel with the world of childhood, its main characteristics, current topics and emerging issues. This analysis is at the basis of the Phygital Play project, a mixed-reality playground in which children can play with or against a robot. The project aims to encourage children to play physically in order to reduce sedentary behaviors, which are recently increasing accordingly to the spread of screen-based activities.**

Design Research; Value-Centered Design; Human-Robot Interaction; Edutainment Robotics;

I. INTRODUCTION

In the next years, Service Robotics will experience a dramatic growth generating new challenges, especially from the acceptance point of view [1]. In particular, the category of entertainment robots, thanks to its playful nature, will assume a strategic role for robot acceptability and adoption. This assumption is the starting point of my research that focuses on how the world of children's play is evolving and how this is affected by the spread of robots.

From the very early stages, my research highlighted a growing phenomenon of physical-digital contamination, which is also called Phygital [2] and robots fully fit into this phenomenon since, as stated by Nourbakhsh [3], they represent a new form of living glue between our physical world and the digital universe we have created. Particularly, the main strength of robots is their physicality: they allow a physical embodiment of characters and elements of the game [4]. Because of this, they reach a high level of engagement [5]. This aspect has to be taken into account as a design challenge that can lead to novel interaction modalities in the everyday life. Therefore, *how can we exploit robot's physicality to create meaningful interaction scenarios*?

This question is at the basis of the Phygital Play project, in which a design research methodology was used to move from a technology-driven approach [6] to a value-centered approach [6]. The Phygital Play project, hence, aims to define a meaningful gaming scenario in which children interact with robots.

II. METHODOLOGY

This project was developed applying an iterative design method, based on traditional models, such as the one of E. Zimmerman consisting of three main phases: analyze, design and test [7]. The first phase of the project mainly focused on the scenario analysis. On one hand the stakeholders were identified and involved in the design process, through brainstorming and co-design sessions, as well as focus groups, questionnaire and intermediate tests. On the other hand, the state of the art of edutainment robotics was investigated through two main actions: a benchmarking about toys, especially robotic toys, and, subsequently a literature review. The first phase was followed by a design phase that includes activities more related to the traditional design practice such as the definition of a concept and the related design of the experience. The design phase is still in progress and it will be followed by a field test with children.

III. RELATED WORK

As evidenced by several studies, the world of edutainment robotics is pushing the boundaries of the Phygital phenomenon by introducing mixed reality game environments. Many studies, as a matter of fact, shows mixed reality playgrounds in which, by exploiting the combination of projectors and depth aware cameras, people can play in virtual environments with physical elements, such as in *PlayTogether* [8], *Twinkle* [9], and *RoomAlive* [10]. A step forward in this scenario is represented by the introduction of robots in the mixed reality game environments. This theme has been largely addressed by Robert et al. [4, 11] who developed game scenarios in which the playgrounds are split in two parts: one half is projected on the floor and the other is displayed on a screen. On these playgrounds, some characters migrate from the virtual environment to the physical allowing children to play with them.

IV. PHYGITAL PLAY

The Phygital Play project focuses on the sedentary behaviors (SB) issue, a growing phenomenon, which may cause an increase of health problems. A new gaming framework is proposed as a step forward in the virtual-physical contamination by placing the robot inside the

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playground and engaging children in familiar games without the use of any additional device. The system consists of a virtual playground, on which people and robot(s) can physically interact by exploiting the combination of a depth-aware camera and a projector. It has been designed to implement several commercial robots (such as Roomba and Jumping Sumo) but the preliminary setup involves the use of Sphero that assumes the role of opponent in a pong-like game. On the basis of the game, the robots will be entrusted of different roles, from a companion, to an adversary, to the avatar of a remote player.

Fig. 1. Phygital Play, preliminary set-up and system concept.

V. Preliminary Results

In order to validate the design choices made so far and to build a deeper understanding of the scenario, two main actions were carried out: a questionnaire and a focus group. The questionnaire was submitted through the institutional mailing lists to employees of Politecnico di Torino and Telecom Italia. The data collected from 511 people, of whom the 40% has children, confirmed that most of people (over 90%) are aware about the increase of screen time due to the spread of web-based activities and the subsequent increase of SB. They also claimed that are concerned about the health issues that can be caused by SB. Concerning the theme of robotic games, more than 60% would allow their children to play with them. These data were confirmed also by the focus group, which involved 6 parents of children aged between 6 and 8 years. The parents were selected on the basis of personal knowledge, and the recruitment was done through a direct email invitation. The parents were asked to discuss about their children habits, robotic toys and the Phygital Play project. The focus group highlighted that the projection is perceived as a completely different dimension, compared to the screens, even if it is equally virtual. The parents gave positive feedbacks regarding the idea to make the children move and play physically with or against the robot as well as about the idea to use existing commercial robots. They also suggested the need to have a wide range of games, in order to avoid boredom and abandonment of the game, and highlighted the importance of a multiplayer modality.

VI. Future Work

In the next months the playground will be tested with children in an educational children museum. This test phase aims to collect data about the effectiveness of the interaction model, to highlight the differences between human-human interaction and human-robot interaction and to observe the children behavior during the game. Subsequently, the project will be enriched with the design of new games and new interaction modalities, to enhance the role of the robot.

VII. Conclusion

The Phygital Play project attempts to take a step forward with respect to the existing research about mixed reality games by placing the robot inside the playground and engaging children in familiar games without the use of any additional device. The emerging play scenario would primarily generate valuable interaction modalities that should reduce sedentary behaviors. Nevertheless, since the playground consists of a platform that supports several games and robots, it allows the implementation of multiple solutions for different context and with different purposes, such as educational games for children museums as well as purely entertainment games for home.

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