Enhancing Long-term Children to Robot Interaction Engagement through Cloud Connectivity

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ABSTRACT

In this paper, we introduce a cloud-based structure to enhance long-term engagement in a pet-robot companion treatment to reduce stress an anxiety to hospitalized children. Cloud connectivity enables to combine human intervention with artificial intelligent multi-agent to bias the Robot Companion behavior in order to foster a better engagement and decrease the drop out during the treatment.

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, Performance, Design, Reliability, Experimentation, Security, Human Factors, Verification

Keywords

Robotics; Robot; Play; Children; Engagement; Long-term

1. INTRODUCTION

Therapy with animal pets has been proved to be successful in several situations [1]. Children tend to develop engagement, empathy, and enjoyment feelings with their animal pets [2]. These feelings reduce their stress and anxiety.

Pet like robots are an alternative to the real pets when improving patient experience at hospitals by being a distractor that reduces anxiety in situations such as before surgery or painful treatments [3]. In [4] a study is presented as well as a comparison of different commercial pet-robot animals to describe the relevant characteristics to foster a useful interaction between pet robots and humans. One of the key parameters to measure identified in [4] is the engagement.

The challenge to increase the engagement between the robot and the child is based on the fundamental that of master-pet bond may emerge between a child and a pet robot with social skills, and it implies a hierarchy between master and pet that could be

improved if the robot has a positive response to a master demand during the long-term interaction [5].

The robot used in this study is the PLEO rb robot. PLEO is a low-cost baby Camarasaurus robot with a bio-inspired behavior that captures attention of the children. However, as every child reacts differently to the same robot stimulus, we establish the hypothesis that inducing a supervised behavioral state to the robot we can enhance the engagement. Through the behavior induction we obtain a customized response of the robot that is proved to reduce the drop out in the human robot interaction [6].

In this paper we introduce a cloud architecture for the coexistence of multiple systems that allows either the end user, a human supervisor, or an artificial agent to induce PLEO behavioral states. In the following we define: 1) the PLEO behavioral parameters that can enhance the engagement, 2) technical set up: how PLEO works and how we can act over the robot, the cloud layout, and how users can contribute to stimulate the PLEO, and 3) preliminary results of test sessions in oncology rooms, waiting rooms, and pre-surgery rooms.

2. PLEO BEHAVIORAL PARAMETERS

The PLEO robot is endowed with a Life OS system that allows the robot to evolve through time and to interact in a bio-inspired way. It is an event-based behavior that plays its implemented micro behaviors like a role game character according to the experience, the acquired skills, and a set of parameters that change over time. To identify the key PLEO behavioral parameters we ran sessions using the robot in a regular school with 20 kids playing with the PLEO in pairs, in different hospitals facilities in one-to-one kid-PLEO interaction and in group sessions with multiple kids and multiple PLEOs at the same time, and in a robotics summer camp with kids who already saw the PLEO robot in the past. Before and after each activity we measured the internal variables of the PLEO robot. Specifically, these variables are: Mood, Physical, Emotion, Health, Feed, Activity, Obedience, and Skill. All of them are in a percentage scale. Values for these variables affect the PLEO's response when interacting with kids. For instance, if the Feed is at 100%, the PLEO will refuse to eat, or Obedience close to 0% means that the PLEO is not following orders. As a real pet, if these parameters are not modified, the interaction can drive into frustration and decrease engagement.

Through the observation, we identify the Physical, Feed, Activity, and Obedience as the key factors that play is significant role in the drop out of kids during the play game with the robot.

3. TECHNICAL SET UP

The technical set up implies the modification of the PLEO robot to expand its connectivity, the implementation of a scalable cloud

layout to manage the data transfer between the cloud agents, and different interactive devices to get better engagement.

3.1 The Improved PLEO rb

To transform a toy robot like PLEO to a cloud system client we need to expand its connectivity minimizing the intervention over the hardware of the system, without modifying its pre-programed bio-inspired behavior, without modifying its embodiment, and keeping a reliable trade-off between power consumption, data transfer, and connectivity to the cloud. Thus, we aimed to implement a new battery system with an embedded Bluetooth antenna that links up to multiple PLEOs to a Raspberry Pi based hub/router.

3.2 The Cloud Concept

The cloud maximizes the effectiveness of the shared resources in a set of devices connected to a network. What we present here is a cloud architecture that allows users and artificial agents to induce behavioral states to a cloud composed of PLEO robot.

Figure 1 depicts a global overview of the project deployed in a private network with a local server on a computer. The local server runs over AMPPS and uses a Linksys N750 router. The treatment to the kids in different places is done with the Pleo rb whose behavior is biased through the cloud and its interactive devices.
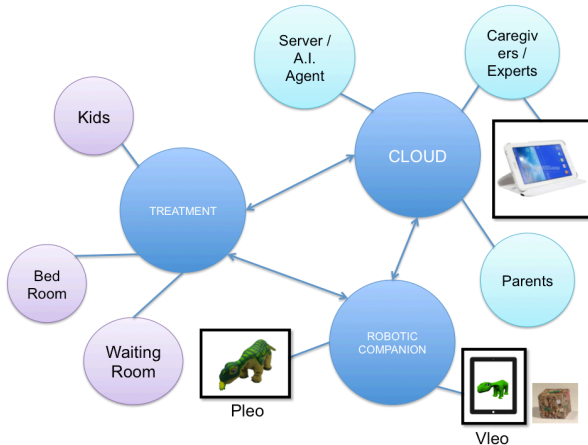

Figure 1. Cloud system layout

3.3 Stimulation Devices

The stimulation devices are those that modify the PLEO internal variables to create the most suitable context to keep the attention of the kids and consequently the engagement. These devices are:

1. The Artificial Intelligent Agent on the server aimed to learn which decision parameters and descriptors are relevant.

1. A stimulation interface to allow caregivers, experts, or parents to induce a customized behavior to the PLEO changing the parameters listed in section 2.

2. The VLEO, a Virtual Avatar that reproduces the PLEO and that interacts with the real PLEOs connected to the cloud. VLEO is controllable through a tangible user interface (TUI) and it is visualized thanks to augmented reality (AR). Thus, kids can see VLEO through a tablet screen, a virtual PLEO that is represented in the physical world by a cube while at the same time acts as a TUI and an AR marker. The cube leads children to control VLEO by gesturing with it. Each cube face has a different PLEO behavior configuration

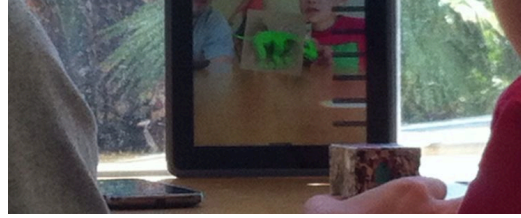and evokes immediate responses from the PLEO. In Figure 2 we can see how it looks like.

Figure 2. The VLEO and the cubic TUI interface

4. RESULTS AND CONCLUSIONS

During the regular school sessions all kids try to feed the PLEO, 34% of them forced the PLEO to eat. All of them prefer the PLEO to be moving most of the time, but 8% would like PLEO less active while they were pick it up. Low obedience level is correlated with kids' complaint about the PLEO, and low activity with lack of touching the robot. Also 100% of the caregivers would like to set up a customized initial state of the parameters before delivering the robots. They agreed that changing its parameters during the intervention can help keeping participants' attention.

8 over 10 interviewed kids after PLEO + VLEO interaction answered that VLEO highly contributes to the enjoyment.

The benefits observed during the sessions with PLEO are: To promote the kids' motor skills, alternative to a dog therapy, to help in cognitive therapy creating specific activities, and parents much happier to see their kids have a good time with PLEO. By enhancing the engagement we ensure better benefits during treatments with the robot.

5. ACKNOWLEDGMENTS

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