



Identifying Needs for the Use of Cyber-Physical Systems for Care in a Pediatric Hospital



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Introduction

Cyber-physical systems (CPS) are intelligent robotics systems, linked with the Internet of Things, or technical systems of networked computers, robots and artificial intelligence that interact with the physical world. In 2016 the project 'Ethical aspects of CPS' has been published by the European Parliament to provide insights into the potential ethical concerns and related unintended impacts of the possible evolution of CPS technology. Issues as delegation of tasks, safety, responsibility, privacy and social relations have been analyzed by this research, with the 2050 year in the horizon [1].

In Saint John of God University Hospital we have been using social robots since 2013 in the context of the collaboration between LaSalle University, Polytechnic university of Catalonia, Autonomous university of Barcelona and Saint John of God hospital, for the development of a social robot for therapeutic use in pediatrics. After several test the robotic platform selected for the deployment in the hospital was PLEO®, a pet robot with the aspects of a camarasaurus baby dinosaur that has different personalities with animals and primary behaviors such as hunger, fear, happiness, curiosity. The PLEO® generates affective behaviors in children aimed at satisfying the needs of the robot. After the deployment of the robots in the hospital a wide range of test and research have been done for to know the dynamics set between the different stakeholders, patients, families, health professionals and the robots [2].

Other technologies such as Immersive virtual reality have been used too for the treatment and prevention of pain and anxiety in front of procedures. Immersed in an era of rapid technological development healthcare professionals cannot just be passive receivers of new technologies and devices and become an industry testing ground but must be involved in device design from the outset [3].

Objectives

To know the requirements that CPS, especially social robots, may have for its use in a pediatric hospital. Identify the needs of the health professionals related to what could offer this kind of technology to improve the quality of care.

Methodology

This work has been divided in two parts. The first was a design thinking session with nurses, like end-users of the technology, to identify needs. The second was a survey with four open response questions administered over nurses of different departments in the hospital that have had contact with the PLEO®.

Results

For the design thinking session we select a group of 9 nurses, all of them were pediatric nurse specialists, they work in different service of the hospital, from hospitalization ward to PICU or ER department. This group of nurse's didn't has previous experience with social robots. The reason of this selection was that we thought that a previous knowledge of PLEO® could induce the participants to think in PLEO® and no in a general robot or technology. We presented the participants the basic elements of the design thinking and asked them about things or aspects of the clinical assistance that the technology could take from the patient, family or environment; we divided these aspects in three initial challenges, clinical, emotional and social aspects.

In the first stage (divergence) of the session all participants, divided in three groups, proposed ideas about this three challenges, in the second stage (convergence) each group select one of the aspects and made a conceptualization of the ideas exposed. After the session the research team carried out an analysis of the results and a holistic conceptualization of the needs identified by the

participants. These needs were grouped in a triangular pyramid model in which the clinical, emotional and social aspects form three hierarchical levels around all the model, in other level we use the three faces of the pyramid to classify the needs in “what”, “how” and “why”.

Against all prognosis the clinical aspects were not those in which the nurses identified a greater number of needs, possibly because the use of technologies for the obtaining of vital signs is habitual in our context; Regarding clinical information there was unanimity in that a device can obtain clinical information from patients, but should not make decisions about this information, the ability to decide is not delegable by nurses and consider technology as an actuator. It was in the emotional and social

aspects where nurses assigned to technology a more relevant role by proposing that new technologies applied to care should be able to act as communication interfaces between the patient and his family, friends, schoolmates, or even with nurses and doctors. They also considered relevant that the new technologies could be reactive to the child’s mood, proposing activities according to the state of the child, as well as the assessment of pain, based on facial patterns combined with vital signs. After this design thinking session we designed an open response survey (Table 1) and we administrated it between nurses with previous experience in the use of social robots, nine nurses of the oncology department were surveyed. The comments on the survey were analyzed following the content analysis method.

Table 1: Open response survey questions.

Questions
1. What areas of the hospital would be more likely to have robot companions?
2. What do you expect from a companion interactive robot? What information and how would you like it give to you?
3. What difficulties faced doctors and nurses dealing with hospitalized children from a perspective of how the child is emotionally? How to manage their anxiety? Which of these difficulties could help solve a companion robot?
4. What features should have a robot: ability to show expressions, talking, interactive, customizable depending on the child, etc? Should the robot perform a role similar to a pet?

About the first question the nurses mainly included the daily hospital, ER department, surgical ward and hospitalization ward like places susceptible to offer robots like a therapy. About the second question the nurses said that the robot could distract, make company, awaken imagination, facilitate the expression of feelings, stimulates the responsibility of caring, interact with children. It is viewed as an alternative to videogames or TV. About the information that a robot could give to the nurse us didn’t obtain any response, maybe because the nurses identified the PLEO® like the unique alternative for robot companion and they didn’t imagine this pet-robot like a clinical device.

About the third question they referred to a problem communicating with patients due to lack of knowledge of them and trust. It shows the robot as a facilitator of expression of feelings and as a mediator between professionals and children, because the robot is a toy. Finally, about the fourth question some people say it should be like a pet, other nuance it should have distinctive aspects facing animals and should not be able to confuse one with the other. They also granted the role of stimulating the child’s caregiver role and no liability with caring for a pet. Should be able to speak and show expressions in terms of feelings. It mentioned that is an alternative to live animals, which cannot enter all areas of the hospital. It must be disinfected. The responses obtained in this survey were coherent with the needs identified in the design thinking session.

Discussion

The nurses that participate in the session identify different needs in which the robot could be useful, against expected the clinical aspects weren’t the one in which the nurses identifies more needs. We interpret this fact because currently there are many devices that address these aspects such as vital signs and the nurses are familiar with them. The aspects where the nurses identified more needs were the emotional and social giving the robot the role of a mediator in the communication between different users for example between the hospitalized child and the school partners or between the family and the nurse.

Although nurses are not willing to delegate decision-making related to clinical aspects they seem to do so in emotional and social aspects, giving to technology, in that sense, a greater degree of autonomy. In line with the recently published European Union guidelines on the use of autonomous information systems, the information obtained from patients belongs to the patients in the custody of the persons who care for them, the technology involved in collecting this information is a mere intermediary [4].

Conclusion

After this work we concluded that is very important to incorporate the professionals that could benefit from the technology in the design phase.

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