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Engaging through her eyes
Embodying the perspective of a robot companion

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Abstract: In response to a change in the use of computers and interactive technologies, traditional Human-Computer Interaction concepts of usability, efficiency and productivity have progressively been enriched with other concepts such as curiosity, empathy, playfulness and affection [1]. Korhonen et al. [2] state that the acceptance of a product depends not only on its utilitarian properties but also on non-utilitarian ones including playfulness. However, even if there seems to be near consensus on the importance of designing interactive systems beyond rational and functional requirements, the way in which this can be achieved is still an open research issue. In this paper we describe our design approach to develop an embodied and playful mobile interface to control a robot companion in a smart home environment.
A major challenge of the research is to engage an older person in rich, empathic and playful interaction with a robot to encourage a prolonged, subtle, and stimulating effect beyond the initial encounter [3]. This challenge is explored through the design of innovative concepts of playful interaction embodying the perspective of the robot companion.

Keywords: embodied interaction, graphical user interface. playful interaction,

1 INTRODUCTION

Embodied interaction describes how meaning in interaction emerges from a bodily and contextual experience. It refers to the way our perception of physical and social phenomena develops in interplay with the world around us. Dourish defines embodied interaction as "the creation, manipulation and sharing of meaning through engaged interaction with artefacts" [4] (p. 126). Since its original definition, the concept of embodied interaction has inspired a number of design approaches considering "embodiment" as the bridge between the physical and digital. In particular this concept emphasises the opportunities of action that the physical world offers and that should not be neglected in the design of digital interactive products.

With this approach as a source of inspiration for the design, this paper explores the possibilities of embodied interaction in controlling a robot companion, namely Care-O-Bot, by an older person in the home environment. Following the principles of designing for embodiment, a graphical user interface (GUI) has been developed exploiting perspective taking to engage in playful interaction modalities with the robotic system.

In this context, the concept of playful interaction explores and expands the range of interaction modes between the digital and the physical enabled by the GUI.

In the following we first describe the theoretical framework that inspired our design. Later we illustrate the GUI and the interaction modalities. Finally we discuss the characteristics of the playful experience associated to embodying the robot's perspective. For doing this, we apply the Playful Experience Categories as defined by Korhonen et al. [2]. These researchers studied the pleasures of play with the aim to understand the underlying fundamental elements of pleasure or play and inform designers. They developed a framework elaborating and expanding the model defined by Costello and Edmonds [5] who derived thirteen categories of pleasure: Creation, Exploration, Discovery, Difficulty, Competition, Danger, Captivation, Sensation, Sympathy, Simulation, Fantasy, Camaraderie and Subversion.

Since these categories focus on pleasurable playful interfaces in interactive artworks, the model has been expanded by Korhonen et al. to address the design of utilitarian products that elicit playful experiences. More design practical notions to achieve playful interaction can be found in the work of Bekker et al. [6]. Together with direct motivational feedback and open-endedness Bekker et al. [7] use social player-interaction patterns as one of their three design values for creating playful interactions. The social player-interactions exploited in their approach is by collaborative and competitive richness of interaction.

The whole framework is fully illustrated in the final section of the paper and applied to our concept of embodied

perspective taking. The objective is to evaluate if the application of embodied principles (continuity, intersubjectivty, contextuality and personalization), might help in engendering playful and engaging interactions.

2 DESIGN

A context dependent and personalized interaction capitalized within perspective taking is one of the concepts of social behaviour that we have been developing in the project. It emerges in an active interplay in context where the elderly takes on the robot's point of view by looking through its eyes. The concept is based on the notion of intersubjectivity, a phenomenological notion that emphasizes that shared contextual activity and consensus is essential in shaping empathic relationships. Our graphical user interface containing context depending action-possibilities, is further build upon philosophical perspectives derived from ecological psychology [8] and phenomenology of perception of Merleau-Ponty [9] An affordance, in Gibsonian sense, is an action-possibility that is enabled by our bodies action-possibilities in relation to those of the 'bodies' in the environment. In the context of the graphical user-interface we approach action-possibilities in the relation the robot has towards objects in the environment.

By extending the reciprocal character of affordance with the subjective experience of context following Merleau-Ponty's thought, we approach action-possibilities in context depending yet embodied manner. Thus action-possibilities are relations between actors and objects or environment. In this case the Care-O-Bot towards objects and environment, therefore the graphical user-interface requires information about states of the objects to be handled by the Care-O-Bot, about the states of the Care-O-Bot himself, the environment as well as the states of the user and its unique approach to its world.

In other words we require a larger picture of context. Lets say, an action-possibility 'making coffee with sugar' requires to know where the user is located (to bring the coffee to), whether the user is thirsty (not to provide coffee over and over again). It further needs from the environment and objects involved whether there are empty and clean cups, as well as sufficient coffee, a clean coffee machine and so on. The likelihood of an action-possibility is also defined by previous preferences and rituals between the robot and the elderly, that can hold in interaction in the long term. We thus utilize desires and factual states of the actors (Care-O-Bot and user(s)) and physical states of the tangible objects and environment.

2.1 Interaction dynamics

Through a tablet interface, the person can see and execute action-possibilities that can be performed by or with the robot at the moment of interaction. The action-possibilities are organized by relevance. In time, the elderly's usage of action-possibilities will influence their relevance with respect to a specific context of use.

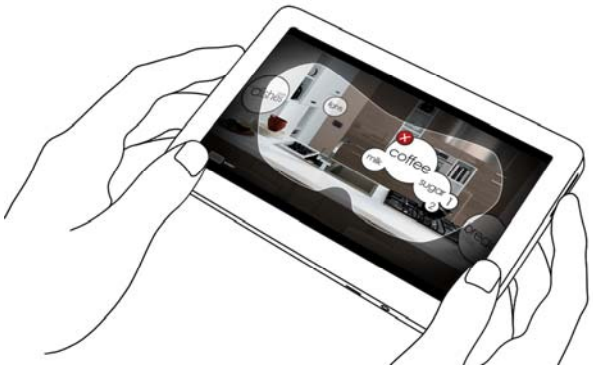

Fig. 1. Seeing through the eyes of the robot, including context depending action possibilities, varying in size depending on their likelihoods.

While selecting a desired action-possibility through clicking the Care-O-Bot will start performing. The elderly persons can see how the task is performed from the Care-O-Bots eyes. On completion of the task, the displayed action-possibilities are updated as the context has changed through the task executed by the Care-O-Bot (e.g. after closing the door, 'closing the door' is most likely not actionable anymore and has been substituted by another action-possibility namely 'open the door').

The robot-view displays what the Care-O-Bot is looking at. This view is covered with a mask indicating a clear vision in the centre and cloudy one outside the centre. As if looking through the eyes of the robot.

While looking the action-possibilities are displayed on the actual objects in the environment. In other words what is behind the robot can not be selected. In order to turn the robot, to look around, the robot can be controlled with a swipe movement. A direct action-perception loop is applied in the interaction, while swiping has started, the vision displayed on the screen starts moving (even before the robot does) using the full image that is used. In other words,

the mask hides part of the view, which will appear on direct interaction.

Fig. 2. By swiping, the elderly person can look through the eyes of the robot and see around. It allows for exploring action-possibilities.

The robot-view contains a perspective from the Care-O-Bot on the environment as elaborated before. This is extended with certain expressions of how the robot feels. When the Care-O-Bot is sleepy (due to performing many tasks) the vision (and thereby mask) will express this to the user besides the 'tired' movement of the executed task, mimicking blinking eyelids.

3 DISCUSSION

As anticipated in the introduction, we conclude our paper by discussing the Playful Experience Categories applying the framework by Korhonen et al. [2]. Our aim is to evaluate if embodied interaction realised through the application of continuity, intersubjectivty, contextuality and personalization principles, might help in engendering playful and engaging interactions.

The categories Captivation (the experience of forgetting one's surroundings), Control (the experience power, mastery, control or virtuosity) and Challenge (the experience of having to develop and exercise skills in a challenging situation) are closely related to Csikszentmihalyi's flow theory [10]. He describes the experience of being in the Flow as being constituted by a balance between one's skills and the challenge; a thin line between boredom and difficultness. Even though we consider captivation to be an objective, evidence of such achievement is yet to be found. As we do not intend to vary the challenge, we hope to achieve this experience through the engagement or embodiment of context the elderly person has with seeing through the eyes of the robot.

Our GUI design deliberately chooses collaboration over Competition (the experience of victory-oriented competition against oneself, opponent or system). The elderly person can together with the robot achieve things that would be impossible without its help. The experience of Completion, finishing and closure, in relation to an earlier task or tension as category is thus addressed in the collaborative making things work. The nature of this collaborative relationship is of Fellowship (the experience of friendship, fellowship, communality or intimacy) and Nurture (the experience of nurturing, grooming or caretaking)

Collaborative Discovery (the experience of discovering a new solution, place or property) and Exploration (the experience of exploring or investigating a world, affordance, puzzle or situation) can be considered as core values of our contextual action-possibility interface design. The embodiment of context, achieved through the eyes of the robot enables the older person to discover action-possibilities and thereby the opportunities the robot provides within the independent live of the elderly person. Seeing what is possible by collaboration, and exploring the world that is shared between elderly person and robot highly provokes playful interaction.

Expression (experience of creating something or expressing oneself in a creative fashion) might occur when action-possibilities emerge through use. But till this happens, action-possibilities are straightforward embodied in the actual possibilities the robot has with its environment. This further limits the Fantasy (the experience of make-believe involving fantastical narratives, worlds or characters) one can have when not considering the explorative element of finding action-possibilities by playing with the eyes.

Sensation (a meaningful sensory experience) is stimulated as the robot is part of the direct world of the elderly person. Even though the movements of performing action-possibilities are stiff and 'robot'-like, the robot is actually there to be part of life. The graphical-user-interface as a tablet filled with 'representational action-possibility labels' is flat and does not allow for meaningful sensory experience)

The category Simulation, an experience of perceiving a representation of everyday life, is rooted in gaming where things are to be done that can normally not be done. This category profoundly contradicts our approach as we intend to achieve an embodiment within a direct interaction with the real world. Therefore we attempt to bypass any representation and utilize the direct sensorial world as it is

to the elderly person and robot and not address digital abstractions.

Subversion, the experience of breaking social roles, rules and norms, might be achieved as meaning emerges in interaction. Though we did not specifically design for this matter.

Sympathy, described as an experience of sharing emotional feelings, is addressed in our embodied perspective interface. Perhaps we have to be more nuanced in this as could argue that the robot does not have feelings, we consider a limitation of an action-possibility informed by the robots properties a feeling of the robot. In other words, in case the robot is not able to perform a difficult task informed by a low battery and overused motors, the graphical-user-interface does reflect these inner states by not showing action-possibilities.

The Thrill category, defined as an experience of thrill derived from an actual or perceived danger or risk, the Eroticism category (the experience of sexual pleasure or arousal), the Sadism category (the experience of destruction and exerting power over others), Relaxation (the experience of unwinding, relaxation or stress relief. Calmness during play), and the Suffering category (experience of frustration, anger, boredom and disappointment typical to playing) are being purposely avoided. The Suffering category, in our view, contradicts with the Captivation category in which the above mentioned experiences are ought to be avoided by a dynamic challenge that matches the elderly person's skills.

The playful interaction design values by Bekker et al [7] as introduced before can be found in our work as well. The direct motivational feedback design value is addressed via continuous-sustained action-perception loops as well as the collaborative achievement of action-possibilities. Here thus we approach the social player-interaction pattern by interactions of collaborative nature between elderly person and robot. The open-endedness design value is provided by the context and the action-possibilities of the robot itself, yet this can be seen as a limiting factor more than an opening. Open-endedness concerns the opportunity to create interaction paradigms in contrast to predefined rules and objectives. To come forth to this design value not only the meaning should emerge within interaction between elderly person and robot but also the growth of action-possibilities from the robots side.

The novelty of the approach relies on an innovative concept of interaction, based on perspective taking. The robot control is addressed via the resonation of older person and robot through shared viewpoints; providing the older person with insights of what is possible for the robot to do in a continuous flow of interaction.

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