Ranger, an Example of Integration of Robotics into the Home Ecosystem

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Abstract. This paper gives an overview of the trend to design robotic systems that can cooperate with humans . It shows how this approach can be applied to home ecosystems taking an holistic approach, taking into account the whole system and its ecosystem.

Keywords: holistic approach, ecosystem, cooperation with humans, domestic service robots

1 Introduction

Since years, predictions say service robotics will massively enter in every home [1]. In Europe, surveys show a general public perception which is still not very open to home service robotics. Robots are perceived as a good tool mainly for dangerous tasks [2]. In the same survey of 2012, a majority of people thinks robots should be banned from typical home service scenarios that include children, elderly or disabled care. Only 13% of the European citizen think robots should be applied in priority to "domestic use, such as cleaning". Also among researchers it has not been clear what robot exactly should do in homes [3]. Pantofaru et al. [3] explored the role of robots in home organization (tidying, storing), and found that robots could have a potentially high impact on this. Similarly, Bell et al. [4] suggest that robots could be used in tidying up scenarios in the domestic environment.

Although only few such systems have entered the consumer market, several researchers took advantage of these few success and studied the acceptance of robotics technology by the users. Bauwens et al. [5] showed that the main factors impacting the adoption of robotics at home are, from the most to the less important:

1. The practical utility
2. The integration into the home ecosystem (physical space, users, habits)
3. The economic utility

Most of the service robots developed in research only look at a subset of these criteria, approaching single disciplines such as HRI, mechatronics or robotic functionality.

In this paper we present an holistic approach and an example of mechatronic implementation looking for a balance between functionality, cost and integration into the ecosystem. We believe that an holistic and interdisciplinary approach can improve acceptance and bring robotics in homes in a faster and more efficient way. Our approach consists in integrating robotics technology into daily objects, making them what we call *robjects*. Robjects can easily blend into the home ecosystem because of the embodiment in an object that is already integrated into the ecosystem and has a clear function in it. Robjects also aim at a close synergy with the users, replacing high technological requirements with better human-robot interaction for collaboration. These principles have already been applied to some successful systems in industry, as illustrated in section 2. Section 3 presents an example of robject and the first results of user tests.

2 State of the art

Although most of the service robots developed in research lab do not meet market requirements and address only part of the requirements, few managed to become successful product. Among them we can find the Kiva systems [6] or the Baxter robot [7], both systems focusing on cooperation with humans, low cost and high added value functionalities. Takayama et al. [8] found that "people would feel more positively toward robots doing occupations *with* people rather than *in place* of people". Transposing the same approach to homes, we developed a robot to help tidying-up the kid's room, which has been considered as an interesting tasks by previous studies [3, 4].

3 The ranger robot

The *ranger* robot (see figure 1a) is a wooden toys storage box equipped with wheels, mechanical eyes, inertial sensors, proximity sensors, inside balance, capacitive external touch sensors, led panels behind the wood walls and sound. It has been designed by an interdisciplinary team including mechatronic engineers, interaction designers, ethnographers and roboticists. Its body and its behavior are shaped to encourage the kids to tidy up the room. Instead of maximizing the robotics functionalities for this type of application, the optimization is made globally, taking advantage to the interaction with the kids. A first short-term study in families show a very high acceptance. The same study demonstrate that the robot can achieve good performances with a minimalist behavior. A longer-term study needs to be conducted to see how far users engage in using the Ranger after novelty effects have worn off.

(a) Ranger robot

(b) User studies in families

Fig. 1: The ranger robot design with one side open to see the electronics embedded in the walls (a) and an image taken during user tests in families (b).

4 Conclusion

Successful industrial robotics systems have shown the path of a smart integration of human and robotic activities, limiting the requirements for the robotic technology and improving performances thanks to a good human-robot cooperation. The concept of *robjects* and the Ranger design follow this path and show how to extend this approach to the home. The robjects concept is based on an holistic approach that integrates interaction design, robotics and mechatronics. Preliminary results show that this approach can increase acceptance of service robotics into the home ecosystems.

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