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Virtual Reality in Healthcare: Medical Simulation and Experiential Interface

Editors:

Brenda K. Wiederhold, Ph.D., MBA, BCB, BCN

Giuseppe Riva, Ph.D., M.S., M.A.

Mark D. Wiederhold, M.D., Ph.D., CPE, FACP, FACPE

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Contents

Robotic Companions for Older People: A Case Study in the Wild

Nicola DOERING [a], Katja RICHTER [a1], Horst-Michael GROSS [b], Christof SCHROETER [b], Steffen MUELLER [b], Michael VOLKHARDT [b], Andrea SCHEIDIG [b], Klaus DEBES [b]

[a] *TU Ilmenau, Media Psychology and Media Design Group*

[b] *TU Ilmenau, Neuroinformatics and Cognitive Robotics Lab*

Abstract. Older people tend to have difficulties using unknown technical devices and are less willing to accept technical shortcomings. Therefore, a robot that is supposed to support older people in managing daily life has to adapt to the users' needs and capabilities that are very heterogeneous within the target group. The aim of the presented case study was to provide in-depth insights on individual usage patterns and acceptance of a mobile service robot in real live environments (i.e. in the users' homes). Results from three cases (users aged 67, 78 and 85 living in their own apartments) are reported. Findings on usability and user experience illustrate that the robot has considerable potential to be accepted to support daily living at home.

Keywords. healthy aging, humanoid companion-type robot, HRI, user acceptance

1. Introduction

Assistive service-robots offer enormous potential to meet occurring challenges in health care caused by severe demographic changes [7]. Robots assisting older people to manage everyday life need to perform a variety of tasks, interact flexibly, and adapt to a wide range of capabilities and health constraints in non-standard situations and environments [2]. Thus, the development of such a device, which is being designed to play a role in the lives of ordinary people, has to be user centered [3]. The design of the system has to adapt to the user's needs in a way that the user does not need to change his/her habits when working with it [8]. Although previous research has addressed senior acceptance of citizens of service robots, studies conducted "in the wild" (i.e. studies with robots autonomously operating in seniors' homes) are lacking [7].

2.Related Work

Currently many service-robots are developed to assist elderly people with functional activities in their daily lives (e.g. medication management, monitoring, emergency help or feeding) [7]. Other developments focus on providing companionship, entertainment, and communication [6]. So far, robot-development is mostly technology-driven and available robots are predominantly prototypes [1]. Social and psychological research is mainly engaged in studying aspects such as embodiment/bodily presence, personality,

empathy, engagement, adoption (the ability of the robot to learn about its users' behaviors, needs and preferences and adjust to them) and transfer (the ability of the robot to change user behavior in the long-term) [7].
Robots supposed to assist the elderly are confronted with a wide range of capabilities and health restraints of the elderly, great variability regarding the environment of private homes as well as manifold tasks that might be solved during the course of the day. For successful purpose individual capabilities, needs and technological possibilities have to match [2]. So far, there is very little experience with such complex scenarios [7].
In this paper we present a case study serving to optimize a companion-type service-robot for health assistance for the elderly supporting everyday life, involving elderly people and testing in everyday scenarios in real-life situations. Therefore, an explorative multi-case study was conducted [9].

3. Case Study

The case study intends to answer the questions whether the target group accepts the developed robot as supposed. Therefore we tested whether the robot (technically) performs well, usability matched the requirements of the target group, and user experience was positive.

3.1 Case Selection

Three older people (aged 67, 78, and 85) with varying health conditions received a service robot and interacted with it within their homes. Case one is a male senior, aged 67, without any major health problems and an affinity to technology (e.g. using PC and smartphone daily). Case two is a single woman, aged 85, who suffers from severe health restraints (diabetes, cardiovascular diseases causing serious balance problems), not using technical devices on a regular basis (apart from TV and telephone). The third case is a 78 year old woman with severe health restraints (cardiovascular and respiratory disease). She is quite interested in using technology (especially frequenting her PC daily) though not experienced. She takes care for her husband (suffering from dementia, diabetes, and severe mobility problems) who lives with her in a two-room-apartment. All three respondents were already familiar with the robotic platform. They got exhaustive test instructions including a training how to use the robot.
All three apartments were mapped and tested before the case study was executed. The apartments provide a challenge for robot navigation because of narrow passages, difficult light conditions, and various immobile obstacles that are difficult to detect (e.g. low jutting edges or glass-topped tables).

3.2 The Assistive Service Robot

The participants were asked to interact freely with the mobile humanoid companion-type robot (see figure 1) offering various functions to facilitate everyday life like video telephony to support social interaction, monitoring vital signs (e.g. measuring pulse rate), or calendar functions for cognitive support including reminders for medication.

The robot could be navigated using a touch display, communicated verbally and nonverbally, and reacted with paraverbal feedback (purring) when stroked at its head [4].

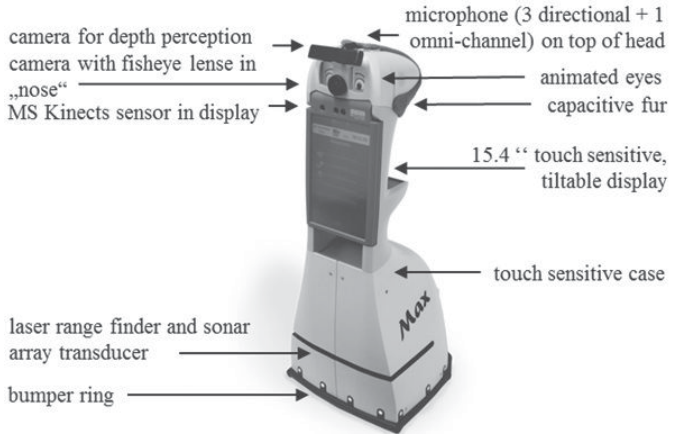

Figure 1. Robotic Platform MetraLabs SCITOS G3

3.3 Criteria Measuring User Experience

Referring to the theoretical framework of the ALMERE model [5], objective usability indicators (effectiveness, efficiency, learnability, and robustness) were measured. A particular focus of user experience is laid on how capable the robot actually is regarding human necessities like companionship. Therefore, safety, joy of use, co-experience, and intention to use [5] as well as satisfaction were measured.

3.4 Data Collection and Data Analysis

Respondents were visited in the morning or early afternoon. They were asked to use the robot’s applications for whatever and as long as they would like to. To assess comprehensive information, objective and subjective measurement methods were combined collecting qualitative and quantitative data.

Throughout the whole test a member of the research team was present observing the situation. The test was recorded on video and audio devices. In addition, field notes were taken. The robot’s activities were logged throughout the whole test (log files).

We used thinking aloud to audio record the subjective impressions of the users throughout the test session. After finishing the test session respondents were interviewed (semi-structured interview guide). In order to assess holistic information, content analysis of transcribed interviews and thinking aloud protocols for subjective data as well as field notes were triangulated with quantitative data from log file analysis (robot's actions and user's input were continually logged) for objective data for each case. Finally, the single cases were compared to find common or contrasting patterns.

4.Findings

4.1 Usability

Although each test session was about the same length (35-40 min), active interaction time with the robot varied (63%, 76%, 97% respectively). Regarding usability aspects, learnability was high although handling applications took some practice. Effectiveness and efficiency were low as robustness was still limited and issues concerning dialogue design arose at the given point in time.

4.2 User Experience

Despite the fact that all three users showed some concern regarding safety and usability, the overall user experience was positive: Respondents (see figure 2) were satisfied, joy of use was rated high.

Figure 2. Users interacting with the Robot.

Co-experience was rated high as well for several reasons: The users individually named the robot (‘Max’, ‘Robbi’, ‘Little One’), welcomed it heartily, and insisted to say farewell. In general co-experience was obvious concerning communication. Although the robot cannot recognize and react to speech, users asked back and commented in a way so that lively conversational sequences appeared. Likewise, the robots non- reactive, random twinkling was interpreted as a positive nonverbal reaction of the robot confirming activities or answering questions. Further, it could be observed, that users were talking to the robot as if it was a human being. They praised it (e.g. “See, if you try, you can do it!”), felt sorry for failures (e.g. “I know that’s difficult, I will teach you.”), ranted (“I told you before, don’t do it!”), cared about its condition (e.g. “Are you tired?”) or even asked for its opinion (e.g. “What would you like to do next?” or “Would you mind to be remote controlled?”). The most noticeable effects of co- experience could be observed when the robot reacted to stroking its head (capacitive fur). In case 1 the user triggered the reaction by accident. Right in the moment when the robot purred, he interrupted his current activity, turning to crawl the robots head for several seconds. The senior of case 2 insisted to stroke the robot at the end of the test session intending to reward its good work (Figure 3 above). The most impressing effect could be achieved in case 3. The users’ husband avoided interacting with the robot because he was afraid of it until he recognized it purred.

Each user acknowledged the intention to use the robot in the future. The user of case 1 could imagine exercising with the robot, especially looking forward to motivating companionship as well as professional feedback. Thus he would appreciate if the robot could motivate him for activities outside the apartment. The senior in case 2 was especially curious about security aspects provided by the robot (e.g. alerting before or assisting in case of emergency). The third senior would use the robot to support her while taking care for her husband (e.g. accompanying and appeasing him if she has to leave the house or to support him with exercising). She also would be delighted to use the robot as a partner for gaming.

5. Discussion

Apart from the necessity to improve usability (e.g. speech recognition should be implemented and navigation needs improvement), especially high ratings of co-experience indicate that the robot has high potential to be accepted as a companion and health supporter in everyday life of older people.

Testing an early prototype comes with limitations: There were technical issues making it difficult to reproduce exactly the same conditions for each test run. The differences that occurred were taken into consideration when interpreting the collected data. Additionally, recruiting adequate respondents from higher age and the intensive pretesting before the field tests are very time consuming. Still, preliminary findings of the case study turned out to be helpful for robot development.

Further research questions need clarification before robotic companions can be introduced to the elderly: 1) Does the robot work robustly over a long time in unknown environments? 2) Will there be effects of habituation in long-term-use – positive (e.g. increasing safety and trust) or negative (e.g. decreasing interest in interaction)? 3) At which times during the course of the day, respectively for which activities, will the robot be seen as supportive or distractive?

So far, the case study is restricted to findings of highly individual usage patterns in a short-term scenario in the wild. Thus, further research with larger samples and long-term scenarios integrating the robot in the seniors' everyday schedule is needed.

References

[1] G.A. Bekey, G.A, Current Trends in Robotics: Technology and Ethics. In: P. Lin, K. Abney, G.A. Bekey (eds.): Robot Ethics. The ethical and social implications of robotics. The MIT Press, Cambridge (2012), 17-34.

[2] M. Decker, Service Robots in the Mirror of Reflective Research. Poiesis und Praxi, 9 (2012), 181-200.

[3] N. Döring, S. Pöschl, H.-M. Gross, A. Bley, C. Martin, H.-J. Boehme, User-Centered Design and Evaluation of a Mobile Shopping Robot. International Journal of Social Robotics (2014), doi:10.1007/s12369-014-0257-8

[4] H.-M. Gross, C. Schroeter, S. Mueller, M. Volkhardt, E. Einhorn, A. Bley, C. Martin, T. Langner, M. Merten, Progress in Developing a Socially Assistive Mobile Home Robot Companion for the Elderly with Mild Cognitive Impairment. Proc. IEEE/RSJ Int. Conf. on Intelligent Robots and Systems (2011), 2430-2437.

[5] M. Heerink, B. Kröse, V. Evers, B. Wielinga, B., Influence of Social Presence on Acceptance of an Assistive Social Robot and Screen Agent by Elderly Users. Advanced Robotics, 23 (2009), 1909-1923.

[6] S. Hutson, L. S. Lim, P. J. Bentley, N. Bianchi-Berthouze, A. Bowling, Investigating the Suitability of Social Robots for the Wellbeing of the Elderly. Affective Computing and Intelligent Interaction, 6974 (2011), 578-587.
[7] H. Robinson, B. MacDonald, E. Broadbent, The Role of Healthcare Robots for Older People at Home: A review. Int. Journal of Social Robotics, 6 (2014), 575-591.
[8] Weiss, R. Bernhaupt, M. Tschegili, The USUS Evaluation Framework for User-Centred HRI. In K. Dautenhahn, K. Saunders, J. Saunders, J. (eds.), New Frontiers in Human-Robot-Interaction. John Benjamins Pub., Amsterdam (2011) 89-110
[9] R.K. Yin, Case Study Research. Design and Methods. SAGE, Thousand Oaks, 2014.