EXPERIENCES WITH A MULTI-FUNCTIONAL ASSISTIVE ROBOT IN RESIDENTAL CARE

Katrin PALDÁN*[a] , Lukas ARNOLD[a] and Walter RITTER[a]
[a] *Fachhochschule Vorarlberg, Dornbirn, Austria*
** Corresponding Author: Katrin Paldán, katrin.paldan@fhv.at*

Abstract. To relieve nursing staff and at the same time maintain or even improve the quality of care, assistance robots must be able to perform multiple functions autonomously, safely and reliably in a complex working environment. So far, there are hardly any field studies with assistance robots over a longer period of time. It is therefore unclear to what extent robots can fulfil these high expectations in real care contexts. This paper presents evaluation results from a 22-month field test with the robot Lio by F&P robotics Switzerland in two care facilities in Germany and Switzerland and provides insights into the extent to which the robot Lio performs relevant tasks in a technically reliable, user-friendly and context-appropriate manner. The findings are based on data from interviews with nursing and care staff, managers and residents, as well as written surveys of nursing and care staff in the living areas where Lio was used. The routine integration of assistance robots into care practice requires not only the solution of technical problems (e.g. safe navigation, linguistic interaction), but also suitable participation approaches on the part of the actors. These should be designed in such a way that not only technology-affine people are addressed, but that everyone is offered the opportunity to try out the technical system and gain confidence in its control and operation. Although the evaluation could not prove any direct benefit in the sense of a noticeable reduction in workload of care givers, most of the interviewees have a positive attitude towards the further development of assistance robots and their use in the context of care. One of Lio's strengths is its stimulating potential, but its usability still needs to be significantly improved in order to be perceived as a helper in everyday care.

Keywords: assistive robots, long-term care, evaluation, multi-functionality, usability

1 INTRODUCTION

The shortage of skilled workers in the care of older adults and the high burden on caregivers are often arguments for the development of care assistance robots. These have the potential to perform assistance services autonomously [1][2]. Assistance robots are expected to provide support in many ways: On the one hand, they should make life easier for caregivers (e.g., by handing out objects). On the other hand, they should provide more safety (e.g., by further investigating conspicuous events) and contribute to healthy aging (e.g., physical activation) and more participation (e.g., psychosocial activation). Their functions therefore promise assistance for nursing and care staff (e.g., transport and service tasks) as well as social

assistance for older adults in care situations (e.g., entertainment, companionship). However, field studies with assistive robots in real care contexts over a longer period are still rare [2]. Challenges for the field use of robots in long-term care are the multi-functionality under non-standardized conditions [3] as well as the complex network of relationships and interactions between Lio, individual actors, and between the actors themselves. In the PUR research project, the use of an assistive robot is tested for 22 months. This paper presents excerpts from the evaluation in the PUR research project and answer to what extent the robot Lio (see Figure 1) from F&P Robotics Switzerland perform relevant tasks in a technically reliable, user-friendly and context-appropriate manner by providing lessons learned extracted on data from interviews with nursing and care staff, managers and residents, as well as written surveys of nursing and care staff in the residential areas where Lio was used.

2 EVALUATION - OBJECTS, SUBJECTS, DESIGN AND METHODS

In the PUR project, the robot Lio from F&P Robotics Switzerland was further developed and tested in a context-adaptive manner in two care facilities. Lio complies with the ISO13482 standard and fulfils the safety requirements for robots in the field of care. As a personal assistance robot for care applications, Lio should autonomously perform a variety of complex tasks and functions. The repertoire of available functions during the project period includes basic functions (such as autonomous navigation, grasping and offering objects, displaying tasks, recognizing keywords, recognizing faces), assistive functions (such as disinfection with UV light, distributing drinks, informing), and social-assistive functions (such as entertainment, physical mobilization).

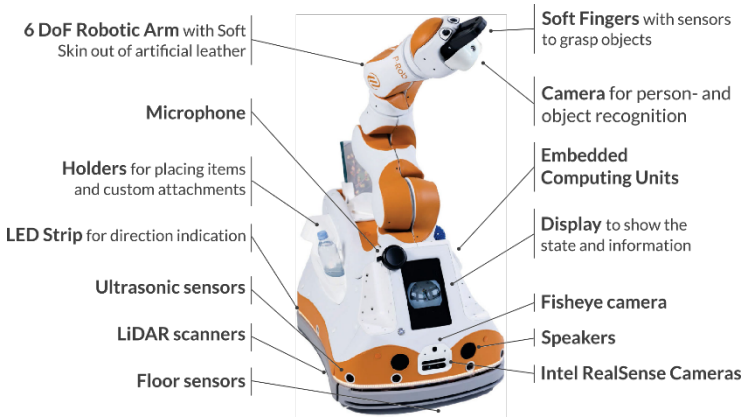

Figure 1. Lio from F&P Robotics Switzerland [4]

In a retirement center in Switzerland and in a care facility in Germany, Lio was used for 22 months in a residential care group with largely dependent residents in need of care. In Oct 2021, surveys with care givers and interviews with care givers, managers in leading positions

in the care facilities and residents were conducted. In addition, log file data from Lio as well as error and observation protocols in the period between Oct 2020 and Oct 2021 were analyzed. The error and observation protocols were created by people in the facilities and submitted monthly for the evaluation.

The criteria for evaluation are derived from several theoretical approaches and include (sub)criteria on system reliability, usability, user experience, social acceptability, societal and organizational impact [5][6].

3 RESULTS – LESSONS LEARNED

The evaluation results based on the interviews, surveys and log analyses show a need for technical optimization, which can be summarized in the following three lessons learned.

- **Less (variety of functions) is more**: Deployment under non-standardized conditions has shown that a multi-function portfolio was too ambitious and that it would be better to initially implement fewer simultaneously running functions and motion sequences that may also have synergies (facial recognition & personalized entertainment, activation & monitoring for security aspects). The learning of new functions and updates must be communicated to all actors, as well as the fact that new (especially innovative) functions have a higher error potential.
- **Involvement of the staff of the care facility in the development**: The close cooperation between care institutions and the developers is resource-intensive, but has led to recognizable improvements in individual functions over the project period (e.g. navigation).
- **Understanding linguistic diversity:** Easy operability via speech is seen as a key function for further development. In the further development of the language module, attention must be paid to reliable recognition of dialects and linguistic variations.

In addition to the technical optimization, the human-roboter interaction and collaboration should also be improved which is summarized in seven lessons learned:

- **The integration and acceptance of a robot in the care context is not only a technical, but also a social process:** The Normalization Process Theory (NPT) [6] and her four components (Coherence, Cognitive Participation, Collective Action, Reflective Monitoring) can give inside in the robots' performance as an actor in a collaborative work environment. Lio still has room for improvement in all four components of the Normalization Process Theory (NPT). *Collective action* receives the highest mean score (MV=2,93; SD=0,74) compared to the other components *Reflective Monitoring* (MV=2,70; SD=0,70), *Cognitive Participation* (MV=2,54; SD=0,79) and *Coherence*

(MV=2,35; SD=0,52) on a five-point rating scale form 5=strongly agree to 1=disagree. Although collective action receives the highest mean value compared to the other components, the evaluation does not go beyond a neutral rating.

- **Broader participation**: When implementing and using Lio, some feel more involved than others. Systematic involvement of all employees in the nursing and care teams is recommended. This could be achieved through appropriate measures that are well integrated into the daily work routine. It is also important that senior management encourages the nursing staff to attend.
- **Ensure competence transfer within care teams**: Care should be taken to ensure that enough staff feel comfortable using Lio and collaborating with developers. The goal would be to have at least one person on each shift who is well versed in the interaction capabilities and can pass them on to other colleagues.
- **Realistic effort estimation**: The learning phase of a robot in an inpatient care context takes time and must be accompanied by development and training personnel.
- **Open and transparent communication**: Awareness must be taken not to raise expectations too high and to address that not only steady progress is to be expected.
- The main **potential for** improvement for a **better user experience** due to AttrakDiff™ [7| is on the Pragmatic Quality (PQ) with the lowest mean value of 3,41, followed by Hedonic Quality in the facet Identity (HQ-I) and the overall attractiveness (see Figure 2). One of Lio's strengths is that he is perceived as sympathic and rather stimulating.

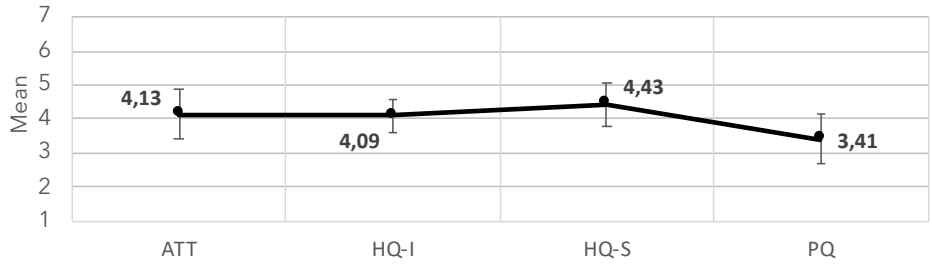

Figure 2. Mean value and standard deviation of four dimensions of the AttrakDiff™ (ATT=attractiveness, HQ-I=hedonic quality-identity, HQ-S=hedonic quality-stimulation, PQ=pragmatic quality) for the assistant robot Lio on a seven point scale determined in a survey with 25 nursing and care workers (low mean values from 1-3 indicate negative to rather negative expression of the word pairs, mean values around 4 indicate an neutral rating and values from 5-7 a rather positive to positive expression)

4 CONCLUSION

The evaluation of the care assistance robot Lio has shown that, in addition to necessary technical optimization, the routine integration of Lio into daily care and support also requires optimization of the human-roboter collaboration and suitable approaches to participation and knowledge enhancement in the usage of robots. Although the evaluation could not show

a direct benefit in the sense of a noticeable reduction in workload could, most respondents are positive about the further use in the care context.

5 ACKNOWLEDGEMENT

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