What do staff in eldercare want a robot for? An assessment of potential tasks and user requirements for a long-term deployment.

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***Abstract*— Robotic aids could help to overcome the gap between rising numbers of older adults in need for care and at the same time declining numbers of care staff. Assessments of end-user requirements, especially focusing on staff working in eldercare facilities are still sparse. Contributing to this field of research, this study presents end-user requirements and suggested tasks, gained from a methodological combination of interviews and focus group discussions with actual staff. The findings suggest different tasks robots in eldercare could engage in, such as "fetch and carry" tasks, provision of entertainment and information, support in physical and occupational therapy, and surveillance. Furthermore, this paper presents an iterative approach that closes the loop between requirements-assessments and subsequent implementations.**

Keywords*— service robotics; edlerly care; requirement analysis; task analysis; focus groups

I. INTRODUCTION

Various authors point out that the proportion of older adults in western society is increasing, whereas the number of employees is declining. Consequently, a shortage in care staff can be anticipated in the near future. Solutions proposed to tackle this challenge comprise the deployment of robots to support older adults who still live in their private homes, or robots that support routines in eldercare facilities ([1], [2], [3], [4], [5], [6], [7], [8]). When it comes to the development of technological aids in elder care several authors state that it is important to assess requirements and acceptance of users to guide future technical interventions accordingly [1], [8], [9], [10], [11], [12], [13]. However, a literature review on socially assistive robots in elder care conducted in [5] showed that despite of these recommendations, few studies take the viewpoint of stakeholders into account when it comes to technical developments of robots. Therefore, referring to [14], they claim that "one of the starting points should be [the] identification and examination of various stakeholder's expectations" [5]. Some papers on requirements of older adults can be found for the development of robots in domestic areas e.g. [15], [3], [16], [7], [12], [13]. But comparably fewer studies report requirements of members of staff in elder care. For example [6] conducted focus groups not just with older adults but also with care-staff about considering the design and impression of Tangy, a socially assistive robot for long-term care. This robot can engage in Bingo games and serve as a teleconference platform for older adults and their families. The questions that led the discussion within the focus group aimed to evaluate the Tangy robot's tasks. Their findings show that care-staff perceived both tasks of the robot positively. Besides the evaluation of Tangy's tasks, care-staff mentioned further tasks that they would consider useful in long-term care, e.g. the robot engaging in simple conversations, providing multiple language support and translation in case of care institutions hosting different demographics, and reminding functions (e.g. remember staff when bed-ridden residents have to be turned over). In another study [17], questionnaires were given to older adults as well as to care staff where they could rate their preferences regarding predefined tasks that a healthcare robot should provide. They found that care staff prioritize tasks like lifting heavy things, monitoring the location of people, switching lights and electrical applications on or off, reminding of daily routines, escorting residents to meals or using the robot as a walking assistance for older adults.

With this paper we contribute to the field of research in different ways. First of all, the findings about care staff's expectations and needs will help to fill the research gap detected by [5]. Second, both presented studies ([6] and [17]) on staff-needs focused either on the evaluation of a robot with predefined tasks or on predefined tasks in a questionnaire, respectively. In our study, staff requirements were assessed in a more open-ended manner. Despite the setting and the robotic platform, no tasks derived from robot-developers or researchers were predefined. This enabled members of staff to think in a more creative way about what they expect from a service robot. Additionally, this study constitutes an example of how findings of an end-user requirement assessment were linked to subsequent technical implementations in the course of the development of a robot for elder-care. Findings of this study provide valuable information about possible robot tasks for long-term autonomous robots and their acceptability in the elder care sector.

Therefore, the leading question of research is: *What do members of staff need and require from a long-term deployment of a service robot in an eldercare hospital?*

II. MATERIALS

This research is carried out in the context of the STRANDS project[1], which aims to develop robot systems that can also be deployed at an eldercare facility. The software for a service robot operating autonomously for long periods of time (i.e. several months) is being developed, enabling it to navigate safely and carry out scheduled tasks without expert intervention. It is designed to support staff in an eldercare facility. One particularity of the project is that the robot is developed in an iterative process that includes the assessment of users and stakeholder's requirements, their implementation and subsequent testing in the process of the robot's annual deployment at a care-hospital in Vienna (Austria). The platform used is a SCITOS robotic platform (see Figure 1). It is 1,75m high and weighs 75kg. A Kinect camera that is mounted on an aluminum frame on top of its head, as well as a laser sensor in the front provide the robot with information about its environment. The robot features a differential drive for mobility. It is equipped with a display at its back and speakers for acoustic output. For safety reasons, a bumper is installed around the bottom of the hull, stopping the robot immediately on physical contact. The robot has got no arms, so its tasks are mainly constrained to monitoring and interaction.

FIGURE 1: Scitos robot

A. *Deployment in a care facility*

The robot is annually deployed at a care-hospital in Vienna (Austria) for extended periods of time during the course of the STRANDS project. The care hospital is specialized in providing long-term care for 350 older adults with severe multi-morbidity, advanced dementia, persons in vigil coma and advanced multiple sclerosis. In total, 465 employees are working at the care-hospital with professions ranging from doctors, care-staff, therapeutic staff, and administration to IT and technical staff and cleaning personal. This depicts the great variety of potential users and of potential profession groups that could profit from the robot's support.

Following technical implementations, the robot was deployed for 15 days (May-June 2014) at the care site during the first year of the project. The aim was to assess the system's capabilities to navigate and interact in a real-world scenario and to get staff and residents acquainted with the robot. For that

[1] http://www.strands-project.eu

purpose it offered information about the EU-project on its screen, but did not offer any care-specific tasks to not prime users about its purpose.

III. Methods

Following [18], we combined two different methodological approaches to identify needs and user requirements of staff at the care site. The first strand of data collection consisted of interviews, the second of a stakeholder workshop at the care site after the 15 days of robot deployment. This combination is beneficial as interviews provide information about employees' experience with the robot [19], which can then be discussed in more detail within the frame of a workshop setting. Subsequently, data collection will be explained in more detail:

A. *Interviews*

Ten interviews were held with different professionals of the care-hospital directly after the deployment of the robot at the care facility (Table 1). All interviewees had encountered the robot. The interviews were held in a calm room at the care facility and were structured along a questionnaire, containing open-ended questions about what tasks the robot could deliver in the subsequent deployments and experiences with the robot. The interviews were audio recorded and transcribed[2]. For analysis, the "f4analyse"[3] software was used. Answers were categorized according to [20] and [21] leading to a reduced set of possible tasks for the robot. Interviewees participated on a voluntary basis and all data were anonymized.

Table 1: Interview participants

Interview partners (10)	
Professions	Physician (1), therapist (1), resident-transporter (1), facility and medical technology (1), quality management (1), IT-support (1), IT-security (1), receptionist (1), PR-agent (1), secretary worker (1)
Gender	6 females, 4 males
Age (years)	26-48

B. *Focus Groups*

After the analysis of the interviews, a stakeholder workshop was held at the care site in September 2014 to discuss the potential tasks derived from the interview analysis in greater detail. Thirteen members of staff from different professions (Table 2) attended. To encourage discussions, questions concerning potential tasks derived from the interviews were presented as well as questions aiming for new ideas regarding tasks and requirements. Findings were noted down. In the end, the notes were collected, thematically clustered and presented again to the plenum. This should help to re-validate the findings. Participants then could rate tasks according to their preference, if they wished. Each participant obtained two rating points (stickers) that could be stuck next to their two most preferred tasks.

Table 2: Focus group participants

Focus group participants (13)	
Professions	Care-staff (4), clinical psychologist (2), physiotherapist (1), IT-support (2), PR-agent (1), resident-transporter (1), facility and medical technology (1), leader of food-supply (1)
Gender	7 females, 6 males
Age (years)	26-61

IV. Results

In the following, findings regarding requirements identified by staff in an eldercare facility are presented, according to the rated priority:

A. *Functional requirements and ideas*

1) *Transportation and guiding (15 rating points)*

The robot should support staff at the care site and deliver medical dispense material to and from care units. This would save the staff many walks between material depots and the units. This function could be extended to have the robot „fetch and carry"mail between different departments. It was suggested that the robot should be equipped with a mail-storage container that can be locked and unlocked by the specific sender and recipient.

Furthermore, care staff imagined the robot to provide a greeting service in the entrance area of the care site to receive visitors and guide them with a "follow-me" mode to offices on the ground floor-level or lifts. Additionally, the robot should be able to guide residents that lost their way to therapy rooms. This task could help saving time for receptionists, as they could request the robot for these tasks.

[2] Full transcripts and found categories can be found under: http://j.mp/aaf_tasks_requirements_study_y1

3 provided by audiotranscription.de

2) Entertainment and information for residents (6 rating points)

Care staff suggested that the robot could act as a mobile information terminal displaying and reminding of current events at the care site. It should also show day, date and time to provide some temporal orientation for residents with dementia. Other suggestions were displaying the current lunch-menu, news and weather information. Also picture galleries or music could be installed on the robot for entertainment purposes. Another suggested possibility was to use the robot as a mobile exhibition-platform of handicrafts from therapeutic groups via displaying pictures of those crafted items. Care staff mentioned that games like memory, quizzes or bingo are often played by the residents and could be installed on the robot. Multi-player games could facilitate contact between older adults, and interactive robot games could make the interaction with a robot a more vivid experience. Such functionalities could entertain residents throughout the day or during waiting situations before therapy sessions or doctor's appointments.

3) Support in therapy (3 rating points)

The focus group developed the idea that the robot could support during occupational therapy, e.g. showing activity instructions or crafting materials on its display. Furthermore, it could accompany the so-called "Nordic-walking" groups, where physiotherapists walk through the building with residents suffering from progressed stages of dementia. The robot could give feedback about the covered distance, calorie consumption etc. As the group likes to sing along while walking, the robot could play familiar hiking songs or natural sounds that remind the residents of walking in the nature (e.g. twittering of birds, cow bells). The robot's information services could also be used during waiting or resting situations for entertainment.

4) Security functions (2 rating points)

Having a robot engaging in security issues has been considered useful for staff at the care site. The robot could support the night watch and patrol corridors to ensure that there are no persons outside their units. Another application could be that the robot detects abnormalities, such as open doors that should be closed, non-functional light bulbs in the corridors or humidity and temperature changes in certain areas of the building. In case of any deviations, the robot could provide responsible staff with a life video stream, pictures or measured data. Another idea was that the robot could survey residents with severe health or cognitive impairments who should not leave the care site unattended, detecting falls and activating emergency calls if necessary.

B. Non-functional requirements and ideas

More requirements and potential tasks were mentioned during the interviews and focus group discussion, but since they were not to be subsumed to the main task-categories or were just mentioned briefly because their implementation would not be feasible within the STRANDS project, they are summarized in this section. Ideas were that a robot could clean the floor while patrolling corridors or empty chamber pots. It could support care staff with physically demanding tasks or function as an additional and mobile PC at single care units. It should provide reminder functions (e.g. medicine) and act as a means for communication (telephone for residents).

Besides explicit tasks, also feedback on the robot itself and its observed behavior was given during the interviews. Analysis showed that staff wishes for a robot that can reliably perceive spoken contents and that can engage actively in conversations. Furthermore, it was found that it is important to make the robot's motion behavior more legible. Employees sometimes were not sure if the robot could detect approaching obstacles or persons, and if it would move out of the way. Members of staff were not always able to read the robot's behavior, e.g. if it would go around a corner or continue its path straight on. It also was confusing when the robot changed its behavior from one task to another. Therefore they suggested that optical or acoustic cues could be displayed in such situations so that users or bystanders could predict the robot's behavior more easily.

And last but not least, a requirement brought up in interviews and the focus group was that the robot should not replace staff but should only be involved in support tasks.

V. Discussion

The central objective of the research in this work was to gather requirements and tasks identified by members of staff in an eldercare hospital following the deployment of a long-term autonomous service robot that should not take over explicit care activities and has got no arms. Subsequently, findings will be summarized and discussed.

A. *Requirements of members of staff in an elder care facility*

This study resulted in meaningful suggestions and ideas for potential robot tasks. Some of the suggestions overlap with findings from [6] and [17], e.g. using the robot as a means for communication, or to remind or survey residents. Stakeholders repeatedly mentioned that it would be useful to have the robot detect persons who should not leave the house by themselves due to bad health or cognitive conditions. The suggestion of entertainment functions for older adults corresponds to findings from [6]. However, results of this study show that besides Bingo, games like memory or quizzes would be appropriate for older adults with dementia. Furthermore, multi-player or interactive robot games could enhance social contact between older residents or the experience of human-robot interaction.

Beyond these suggestions, our findings present some new potential deployment-areas for a long-term robot in eldercare. Different professional groups could profit from robotic assistance: receptionists consider a bellboy function (i.e. guiding of visitors) useful. Care-, technical- and administrative-staff could profit from a reliable "fetch and carry"-functionality of the robot to transport medical dispense material, other items or mail within the house. The importance of such tasks was indicated by high rating points. However, successful implementation of such tasks depends on the deployment of a robot with arms.

For diversion of older residents, members of different staff groups imagined that the robot could inform residents of in-house events as well as current news. Physical and occupational therapists as well as clinical psychologists proposed that the robot could play a stimulating and motivating role during therapy sessions. Yet some limitations need to be considered: the idea that the robot could fetch and carry crafting material would again require a robot with a gripper. Introducing a robot that shows crafting instructions on its display would be suitable for cognitively fitter patients, but not for persons with severe dementia, who probably are not able to follow instructions without any (human) help.

Staff members from technical and IT services as well as from night watch suggested that a robot could support them by detecting unusual activities in the house.

These findings show that there are versatile possibilities to deploy a robot at an eldercare facility that could be considered as starting point for the development of assistive robots in eldercare.

In addition to that, interview analyses showed that it is not only important for a robot to provide members of staff with useful tasks but that the robot also needs to be capable of meaningful conversations. This is also in accordance with findings from [6]. Since not only members of staff but also older adults wish for robots with conversation capabilities [4] [22], future development of robots should also focus on this aspect as it influences end-users' interaction experience with the robot.

Members of care staff did not perceive the robot legible enough. Thus, future development should equip robots with cues to enable users and bystanders to understand what the robot is doing or will be doing next. A study [21] showed that indicator flashlights or movements of the robot's head in the direction of motion could help to enhance the understanding of the robot's behavior.

B. *Linking requirements and robot development*

Results gathered within this study were incorporated in the advancing development of the STRANDS-robot. Consequently, tasks that were rated highest and that were realizable with the armless SCITOS-platform were implemented for the robot's second deployment at the care site. These were:

1. Bellboy-task: the robot guided visitors to rooms, lifts and offices
2. Mobile info-terminal: the robot displayed date, day, time, news, weather information and picture galleries on its display
3. Therapy-Companion: the robot accompanied walking groups for older adults with dementia, playing hiking songs, natural sounds and providing entertainment during waiting and resting phases.

An evaluation of these tasks and perception of users will be issued when collected data are analyzed.

VI. Conclusion

We presented findings of our task and user-requirement analysis for the long-term deployment of the STRANDS autonomous robot at an elder care hospital in Vienna (Austria). This paper particularly focuses on requirements of members of staff to identify tasks a robot could perform to be of useful assistance, bearing in mind that it lacks arms/grippers and should not engage in direct care activities. It was found that tasks like "fetch and carry", guiding, entertainment and information for older residents of the care site, support in occupational and physical therapy, and monitoring and surveillance are considered useful for such a robot. Furthermore, the robot should be able to engage in meaningful conversation and its behavior needs to be legible. Thus, this study points out that there are many different tasks a robot could engage in to assist at a care facility, providing starting points for future robot development. Additionally, findings were directly linked to further implementations in the development of the STRANDS robot, thus closing the loop between task and requirements analysis and robot development.

Acknowledgment

The authors thank members of staff for their interviews and participation in our workshop. The research leading to these results has received funding from the European Community's Seventh Framework Programme under grant agreement No. 600623, STRANDS.

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