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 and at the same time declining numbers of care staff. Assessments of end-user requirements, especially focusing on staff in eldercare facilities are still sparse. Contributing to this field of research this study presents end-user requirements and task analysis gained from a methodological combination of interviews and focus group discussions. The findings suggest different tasks robots in eldercare could engage in such as "fetch and carry" tasks, specific entertainment and information tasks, support in physical and occupational therapy, and in security. Furthermore this paper presents an iterative approach that closes the loop between requirements-assessments and subsequent implementations that follow the found requirements.**

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

I. INTRODUCTION

Various authors point out that in western society the proportion of older adults is increasing whereas the number of employees is declining. Consequently they claim that in future a shortage in care staff can be anticipated. As a probable solution they propose either 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 technical 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], [9], [10], [11], [12], [8], [13]. However, a literature review about socially assistive robots in elder care conducted by [5] showed that despite of these recommendations just a few studies took the view of stakeholders into account when it came 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]. For the development of robots that are deployed in private homes some papers on requirements of older adults can be found e.g. in [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 can serve as a teleconference platform for older adults and their families (for more information about their robot, please have a look in the cited paper). 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 like the robot engaging in simple conversations, provide multiple language support and translation in case of care institution hosting different demographics and fulfill 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 prioritized 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 having the robot as a walking assistance for older adults.

With this paper we want contribute to this field of research: first of all should further findings about care staffs expectations and needs help to fill the research gap detected by [5]. Second, both presented studies on staff-needs focused either on the evaluation of a robot with predefined tasks or on predefined tasks in a questionnaire. Within this study staff requirements were assessed in a more open manner. Despite the setting and the robotic platform no tasks derived from robot-developers or researchers were predefined. This should enable members of staff to think in a more creative way about what they themselves 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-acre. 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

One project that focuses on developing a robot that can be deployed at an eldercare facility is the EU-funded FP7 project STRANDS. Over the four-year-course of the project a long-term autonomous service robot is developed, that can navigate without human intervention for longer periods of time and that should successively take over useful tasks 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 thereafter their testing in the process of the robots deployment at a care-hospital in Vienna (Austria). Within the project a SCITOS robotic platform is used. The robot has a green hull and is cone shaped. Its round head is made out of plexiglass with two big eyes. 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 laser sensors, in the front and in the back, provide the robot with information about its environment. The robot features a differential drive for mobility. It is equiped with a display at its back and speakers for acoustic output. For safety reasons a bumper is installed around the bottom of the hull. If it is hit, the motor of the robot stops immediately (Fig.1). The robot has no arm as the emphasis of the project is not to develop a care-robot that engages in any physical care activities but to develop a service robot that can support staff at a care facility with any possible other tasks.

FIGURE 1: SCITOS ROBOT

A. *Deployment in a care facility*

Every year of the project the robot is deployed at a care-hospital in Vienna (Austria). 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, administrative workers 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 robots support.

Subsequent to 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 technically test the system in a real-world scenario and to get staff and residents acquainted with the robot. Therefore it offered information about the EU-project on its screen. However, no care-specific tasks were provided yet to give users freedom to hypothesize about possible tasks and requirements for this service robot.

III. METHODS

Following [18] we combined two different methodological approaches to find out about 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. This combination is beneficial as interviews provide information about the employee's experience with the robot [19] which can then be discussed in more detail within the frame of a work-shop setting. Subsequently data collection will be explained in more detail:

A. *Interviews*

Directly after the deployment of the robot at the care facility ten interviews were held with different professionals of the care-hospital (Table 1). All interviewees had at least 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 overtake in the subsequent deployments and about experiences with the robot. The interviews were sound recorded and transcribed[1]. For analysis the "f4analyse"[2] software was used. Categorization was done according to [20] and [21]leading to categories for possible tasks for the STRANDS robot. Interviewees took part 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 that derived from the interview analysis in more detail. Thirteen staff members 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 in regard of 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 got the chance to rate their preference of tasks on a voluntary basis. For that reason each participant obtained two rating points (sticker) 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

Subsequently, findings regarding requirements identified by staff in an eldercare facility will be 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 ways between material depots and the units. This function could be extended to have the robot „fetch and carry" mails between different departments. Therefore it has to be taken care of that the robot is 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 ground floor-level or lifts. Additionally the robot should be able to guide residents that easily lose their way to therapy rooms. This task should help saving time-resources of receptionists, as they could forward informing and guiding visitors to the robot.

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

Care staff suggested that the robot could act as a mobile information terminal that displays and reminds of current events at the care site. Furthermore it should show day, date and time as it provides some orientation in time for residents with dementia. Other suggestions were displaying the current lunch-menu, news and weather information.

[1] Full transcripts and found categories can be found under: http://j.mp/aaf_tasks_requirements_study_y1
2 provided by audiotranscription.de

Also picture galleries or music could be installed upon the robot to entertain residents. Another possibility could be to use the robot as mobile exhibition-platform of therapeutic handicrafts via displaying pictures of the crafted items. Care staff mentioned that games like memory, quizzes or bingo are often played by the houses residents and could be installed upon 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. These functionalities could entertain residents throughout the day or during waiting situation before therapy or doctor's appointments.

3) Support in therapy (3 rating points)

During the focus group the idea was developed that the robot could be of help during occupational therapy e.g. showing activity instructions or crafting materials on its display. Furthermore it could accompany the Nordic-walking groups where physiotherapists walk twice a week with highly dement resident through the building. The robot could give information about the covered distance, calorie expenditure. As the group likes to sing along while walking the robot could play familiar hiking songs or natural sounds that remind the residents on walking in the nature (e.g. bird songs, cow bells). For entertainment the robots information services could be used during waiting or resting situations.

4) Security functions (2 rating points)

To have a robot engaging in security issues seemed 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 like 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 abnormalities the robot could provide responsible staff with a life video stream, pictures or measured data. Another idea was that the robot could surveil residents with severe health or cognitive impairment who should not leave the care site unattended, detecting falls and activating emergency calls if necessary.

B. Non-functional requirements and ideas

During the interviews and focus group discussion more requirements and potential tasks were mentioned but as they were not to be subsumed to the main task-categories or were just mentioned briefly as 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 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 is important to make the robots 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 robots behavior e.g. if it would go around a corner or continue its path strait 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 easier predict the robots behavior.

And last but not least a requirement that was distracted from the interviews and was issued during the focus group was that the robot should not replace staff but should just undertake supporting tasks.

V. Discussion

The guiding question of research was what requirements and tasks members of staff in an eldercare hospital have identified following the deployment of on a long-term autonomous service robot that should not take over explicit care activities and thus lacks an arm. As [5] point out this field of research needs more attention to guide robot development accordingly. This study contributes to this open area of research as it presents useful ideas for potential-robot tasks obtained from actual stakeholders and end-users. Subsequently findings will be summarized and discussed.

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

This study resulted in some meaningful suggestions and ideas for potential robot tasks. Some of the suggestions overlap with findings from [17] and [6], e.g. having the robot as a means for communication, reminding or surveillance of 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. That members of staff at the care site perceived entertainment functions for older adults as useful, corresponds with findings from [6]. However, findings 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. It was found that within the care context different professional groups could profit from the robots assistance: receptionists consider a bellboy function of the robot 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 mails 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 distortion of older residents members of different staff groups imagined, that the robot could be useful to inform residents of house internal 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 ongoing therapy sessions. But 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 cognitive fitter patients as such with severe dementia probably are not able to follow instructions without any help.

Staff members from technical and IT services as well as from night watch suggested that a robot could support them, detecting abnormal 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.

Additionally interview analysis showed that it is not only important for a robot to provide members of staff with useful tasks but that it is also necessary that the robot is capable of meaningful conversations. This goes in line with findings from [6]. As 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-user’s interaction experience with the robot.

Another finding of this study shows, that members of care staff did not perceive the robot legible enough. Thus future development should equip robots with cues that can 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 robots head in direction of motion could help to enhance the understanding of the robots behavior.

B. Linking requirements and robot development

Results gathered within this study were entered in the advancing development of the STRANDS-robot. Therefore tasks that were rated highest and that were realizable with the armless SCITOS-platform were implemented for the robots second deployment at the care site:

1. Bellboy-task: the robot guided visitors to rooms, lifts and offices
2. Mobile infoterminal: 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.

How these tasks were perceived and evaluated will be issued when collected data are analyzed.

VI. CONCLUSION

In this paper we presented findings of our task and user-requirement analysis for the STRANDS long-term autonomous robot and its deployment at an elder care hospital in Vienna (Austria). This paper especially focuses on requirements of members of staff of the care site to find out what tasks a robot could perform to be of useful assistance, bearing in mind that it has no arms 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 some potential useful tasks for a robots long-term deployment at a care facility. 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 with to assist at a care facility on a long term basis, therefore providing potential starting points for future robot development. Additionally findings of this study 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.

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