

# Designing a Social Robot Companion to Support Homecare: Usability Results

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**Abstract.** Earlier studies show frail seniors often experience loneliness and depression. Moreover, frailty can lead problems with medication and nutrition patterns. The availability of family care and/or nursing care at home is limited. Digital companions, such as social robots, could complement homecare nurses, thereby improving the quality of care to frail seniors. The Guardian project has co-designed with end-users, a social robot providing social company and health support. To assess the digital and co-created solution, usability evaluations have been conducted with 43 participants distributed as fairly as possible between frail seniors, family carers and professional nurses; in three different European areas: The Netherlands, Italy and Switzerland. The goal of this study is to evaluate if the GUARDIAN solution is accepted by the target users and also gather data on how to improve the system for ensuring added-value in home care. The iterative method based on user-centered approach put the end-users at the centre of the usability evaluation. Through thematic analysis of the qualitative datasets, we conclude that a high number of users accept the solution and describe it as useful. End-user needs have been mainly addressed but some new improvements have been pointed out by the participants and some other needs have been uncovered.

**Keywords.** User-centered design, usability evaluation, coaching technology

## 1. Introduction

Due to the overall increased life expectancy, the elderly population is growing constantly, raising lot of concerns regarding home care. Depending on the Urban Data Platform Plus of the European Commission, “by 2070, European life expectancy is expected to increase to 88.2 years. The old-age dependency ratio is expected to almost double”. [1] Furthermore, the baby boomers generation attaining age of retirement and the fertility being below the replacement level, will lead to drastic issues. The European elderly population is “expected to accelerate during the coming decades. The proportion

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of the population 60+ in the 15 member states of the European Union will increase from [...] 32.4% in 2030". [2] This problematic leads to significant consequences in home care demands. The number of carers is expanding but will not be sufficient to fill the increasing gap and to offer better quality of care to seniors who want to stay independent at home as long as possible. By dint of increase, health institutions and politicians will have to set up and invest in future trend, such as robotics supports.

The Guardian project provides a co-designed social robot aiming to support frail seniors in their daily life and give the carers, either professional or relatives, data to adapt the care they provide. To be constantly informed on the seniors' health situation, carers have an application with which they can send meal or/and medication reminders, well-being or/and sleep quality requests, suggest personalized activities, add appointments to the seniors' calendar and have overviews of the seniors' answers. All these set-ups are dependent on the patient personal preferences and needs. Data are stored in a cloud and distributed to the robot, which will support the senior by reading aloud the message received on the seniors' tablet; for example, *Hi John, how are you doing today?* Once the item received, the frail seniors can answer on the tablet and remotely inform their care network, who will receive notifications and responses overviews on their own application.

The social robot also supports the passive assessment of the senior emotion through its audio sensors (i.e., senior voice captured with microphones). Speech emotion recognition (SER) was selected, instead of an image-based process, due to its smaller footprint (i.e., data acquisition, processing and transfer from the robot) and its acceptability by the end-user population [3]. The emotions are recognized by a state-of-the-art machine learning model [4]. The passive assessment of emotion in the individual interacting with the robot is important. This information could be used by a formal or an informal carer to support a senior in their everyday life. For example, the senior could feel safer at home knowing their carers can provide emotional support if needed. The carer can also be reassured about the senior state via the Guardian's social robot.

## 2. Methods

The user-centered approach allows to involve end-users during the design, development and evaluation of the GUARDIAN e-Health solution [5, 6]. The aim of this method is to iteratively improve the concept based on user inputs, resulting in a solution that optimally corresponds to our target users. When data is gathered from the end-users' assessments, improvements are done thereafter on the system; to be sure that the final product (robot and applications) will correspond as much as possible to their needs and expectations.

End-users have been invited to interviews lasting an hour and a half. Moderators made them perform some tasks in a simulated environment (laboratory or health institution) and asked them about their overall impressions, the quality of the solution and the acceptability of the robot as a life companion. Through these open and qualitative questions end-users assessed the usability of their respective applications.

Collected data from the usability testing have been anonymized and cautiously entered into an Excel file, in order to allow every country to simultaneously share results. In parallel a list of improvements, bugs, issues, new features, has been created to help technical partners to be easily acknowledged of the modifications to be done.

A total of 43 frail seniors, informal and formal carers have been invited, one by one, to discover and use the system, in three different sites: Switzerland, Italy and the

Netherlands. To be included in the study, seniors had to be frail, more than 65 and needing home care; relatives and health professionals had to be experienced in home care for frail seniors for more than a year. All participants had to have a good understanding of the interview’s language.

Seniors interviewed were accustomed to use smartphones, tablets and computers which made it easier for them to assess the system. Relative and healthcare professionals invited did not necessarily have a direct link to the elderly who tested Guardian.

3. Results

To confirm end-users’ general impressions and assess their use satisfaction level, a questionnaire has been submitted to participants. The questionnaire used is not the System Usability Scale (SUS) usually presented in usability evaluations, but the Computer System Usability Questionnaire (CSUQ) [7], which is more complete than the SUS and not time-consuming. This questionnaire includes 19 question-items rated on a 7-point Likert scale from strongly disagree (1) to strongly agree (7).

According to the IBM scores (see Table 1), the end users are satisfied by Guardian’s system. Frail seniors rated the system with higher scores than both type of carers. These results are maybe due to the simplicity of the seniors’ application. Conversely, informal caregivers seem to be the most skeptic ones. This fact is due to their lack of confidence in an older person’s technological skills or because they think the solution is not yet adapted to the person they are caring for. The Guardian system, including both applications and the robot, received good rates and looks promising. Even if some improvements and added features have been asked out by users, this coaching solution is evaluated as easy to use, attractive, and meeting the need and expectations of the targeted population.

**Table 1.** IBM Computer System Usability Questionnaire 1 to 7, where 7 means completely agree with the statement. FS means frail seniors, IC means informal carer and FC means formal carer.

Item	14 FS	13 IC	16 FC
Overall, I am satisfied with the ease of the system	5.9 ± 0.8	5.1 ± 2.0	5.4 ± 1.5
It was simple to use the system	6.1 ± 0.8	5.1 ± 1.4	5.5 ± 1.2
I could effectively complete the tasks and scenarios	6.1 ± 0.8	4.6 ± 1.4	5.4 ± 1.4
I was able to complete the tasks and scenarios quickly	6.6 ± 0.8	4.8 ± 1.0	5.2 ± 1.5
I was able to efficiently complete tasks and scenarios	5.8 ± 0.8	5.3 ± 1.9	5.0 ± 1.2
I felt comfortable using this system	6.9 ± 0.8	5.3 ± 0.3	5.8 ± 1.2
It was easy to learn to use the system	6.7 ± 0.8	5.3 ± 0.5	6.0 ± 1.4
I believe I could become productive quickly using the system	5.4 ± 0.8	5.6 ± 2.4	5.7 ± 1.1
The system gave error messages that clearly help me to fix it	4.4 ± 0.5	2.6 ± 2.4	3.4 ± 1.8
When I made a mistake, I could recover easily and quickly	5.1 ± 0.5	3.1 ± 2.1	3.6 ± 2.1
The information provided with the system was clear	6.4 ± 0.8	5.1 ± 0.9	5.1 ± 1.1
It was easy to find the information I needed	5.8 ± 0.8	4.9 ± 2.1	5.4 ± 1.2
The information provided was easy to understand	5.9 ± 0.8	5.2 ± 1.5	5.4 ± 1.2
The information was effective to complete tasks and scenario	6.0 ± 0.8	5.2 ± 1.2	5.6 ± 1.5
The organization of information on the screens was clear	6.7 ± 0.8	5.3 ± 0.5	5.7 ± 1.5
The interface of the system was pleasant	6.6 ± 0.8	5.5 ± 1.0	5.8 ± 1.6
I liked using the interface of the system	6.8 ± 0.9	6.1 ± 0.4	6.1 ± 1.1
This system has all functions and capabilities I expected	5.3 ± 0.7	4.9 ± 1.8	4.6 ± 1.6
Overall, I am satisfied with this system	6.2 ± 0.8	5.2 ± 1.4	5.7 ± 1.7

### 3.1 Major concern: robot interaction and added values

Seniors assessed the system as being nice and described it positively. They all managed to use the tablet application proving that the system is suitable for seniors as it is really simple to use. Their main concern was the basic interaction provided by the system. To improve interaction options, some IA based interaction adding should be set up; such as answering the robot directly without having to use the tablet.

Participants have commonly defined the system as a good daily help. Frail seniors who are living alone will have some type of company and a fun tool to remind them to adhere their treatment. Many of the seniors (N=10/13) feel safe as they know relative and professionals follow them remotely. Carers also liked the system as the system offers qualitative data, reducing then their chronic stress and anxiety.

## 4. Discussion

Many carers and seniors expressed their concern regarding the use of a tablet and agreed on using a Guardian voice commands instead. Next prototypes will then aim to ensure more interaction between the senior and the social robot. One of the solutions could be offering to seniors' bilateral ways to discuss with the robot or to provide more information on the answers given by introducing vocal messaging to be send to carers in real time. Frail seniors also want to have greater power of action, such as implementing their appointments by their own, be able to call, send a message to their care network.

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