GUARDIAN

The social robot companion to support homecare nurses

D4.4 Beta pilot tests results

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Author(s):	Gosetto, L. (HUG)
Lead partner for this deliverable :	Gosetto, L. (HUG)
Contributing partners :	Guebey, J. (HUG), Trabelsi, A. (HUG), Bevilacqua, R. (INRCA), Amabili, G. (INRCA), Benadduci, M. (INRCA), Margaritini, A. (INRCA), Ter Stal, M. (Vilans), Hofstede, B.M. (Vilans)

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Guardian

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1 Executive summary

To evaluate the third prototype of GUARDIAN's system, beta pilot test have been conducted in Switzerland, Italy and the Netherlands. Beta pilot tests were set up to see how the end-users interact with the GUARDIAN eco-system in their daily life, at their home, with the system co-created. The tests allowed us to purpose future improvements to be done on the system. Deliverable D4.4 contains the findings from the evaluation of the beta version of the GUARDIAN system, consisting of the caregiver application, the senior application and the robot. Most important findings are the appreciation of participants about the company it can give to the elderly, and the design of the robot. In general, they wish for more communication and more accessibility to be able to fully enjoy the system and to make it work for their needs. Participants suggested more possibilities for the seniors to interact with their formal and informal caregivers, as they show great interest and creativity in improving the GUARDIAN system.

Acronyms used in this deliverable	
VIL	Vilans
CCARE	ConnectedCare Services B.V
SRS	Smartrobot.solutions
JEF	JEF S.r.l.
TU/e	Eindhoven University of Technology
UNIGE	University of Geneva
HUG	University hospitals of Geneva
UNIVPM	Università Politecnica della Marche
INRCA	National Institute of Health and Science on Aging
ZNWV	Zorggroep Noordwest-Veluwe
FC	Formal caregiver
IC	Informal caregiver
FS	Frail senior

2 Introduction

The Beta Pilot Test (BPT) was conducted from September to December 2022. Frail seniors participated to test the GUARDIAN robot at home with relatives, and professional carers who were invited to follow the data gathered by the system through the caregiver application.

Participants in the Beta test had to be available for using the GUARDIAN system for at least 2 weeks. They were asked to test the system in a triad (a frail senior, a formal carer and an informal carer was the optimum design, however not obligatory). Since then, iterative sessions have been designed to involve participants in-situ; an actual home environment. Feedback and experiences of all participants were collected through interviews and questionnaires.

In the Netherlands, participating entailed that two robots (Misty and Liz) were installed sequentially at the home of a senior, both for one week. Besides, the corresponding (in)formal caregivers were asked to make use of the caregiver application during the two weeks of testing.

3 Method

3.1 Protocol

The beta pilot test (BPT) is a summative evaluation that took place at the seniors' home to assess the level of efficacy, desirability and worthiness of the third and last prototype. During this test period, end-users highlighted *if*, *why* and *how* the GUARDIAN system has impacted their daily life/work and if they would like to buy and use such system for their home care.

BPTs were planned to be displayed in two sessions: one preliminary session aiming to inform and train participants and another one, more test specific where GUARDIAN was installed at the seniors' home. The first one started in M32 (July 2022) and the second one in M34 (September 2022) with the expectation of enrolling 90 participants.

These participants (seniors, informal carers and formal carers) were asked to use the GUARDIAN's services daily over two weeks, in order to evaluate the final prototype (P3) and share their impressions afterwards through open and closed questions. The following themes were evaluated (dependent variables): ease of use, acceptability, social connectedness, ethics RI, Willingness to pay,

Test – Independent Variables

1) For the caregiver application, we let carers create their own customized message for reminders.

2) For senior's tablet, we added sleep mode, the possibility to change the voice and more volume

3) As for Misty robot, we added sounds when touching the robot for more lively interaction, the possibility to put misty to sleep when tilting the head, and more follow-up answers

Differences per country in protocol

Italy: the BPT lasted about 6 weeks per end user, resulting a deeper analysis of outcomes (more questionnaires asked); the frailty of the senior was not an inclusion criterium, since it has not been mentioned in the protocol approved by National ethical committee several months earlier the beta test. Moreover, one formal caregiver (a physiotherapist expert with older people) followed personally all the seniors, whereas the other 9 formal caregivers experienced the app with real data in focus group sessions.

Switzerland: In Switzerland, although the plan was to conduct the test at participants home over two weeks, we knew we would have some difficulties recruiting participants because a big home nurse company cannot be involved in a HUG project. Therefore, 3 focus groups were created for the last 11 participants including: 3 formal caregivers, 5 informal caregivers and 3 seniors.

Netherlands: ***Comparison Misty and Liz***

In the GUARDIAN project, the Misty robot was used as robotic interface. The Misty robot includes a moving head, moving arms, and various sensors and actuators. In designing GUARDIAN prototype 3, we aimed to create a true social companion for the frail senior users. As part of the iterative design process, we have conducted a comparative evaluation of both Misty (a social robot with moving arms, moving head, robot look&feel), and Liz (a tablet-based social robot without the robot look&feel). This evaluation aimed to better understand the added value of the physical manifestation of Misty in terms of social qualities and bonding. The Liz companion was developed by ConnectedCare as a digital therapy assistant and is currently piloted in 4 EU countries. Liz also supports day structure and is also connected to the same caregiver application as GUARDIAN. To make a fair comparison in the beta evaluation, we made sure that the functionalities of the GUARDIAN system in Liz were similar to the functionalities in Misty. The price of Liz is considerably lower, with hardware in the range of 300-400 Euros vs. Misty with 3000-4000 Euros. See appendix A for more detailed information about the comparison between Liz and Misty.

Figure 1: Digital Coach Liz

3.2 Participants criteria

Formal caregiver (FC) inclusion

- Providing home care
- Living in [country of the study] or cross-border workers
- At least 1 year of work experience
- Being at least 18 years old
- Good written and oral comprehension of the local language

Informal caregiver (IC) inclusion

- Being relatives or close friends of a senior receiving home care
- Does not live together with the senior
- Providing frequent support/care on a daily or weekly basis
- Being at least 18 years old
- Good written and oral comprehension of the local language

Frail senior (FS) inclusion

- Being 65 years old or older
- Receiving home care
- Considered frail (score of ≥ 4 on the Groningen Frailty Indicator or other indicators)
- Good written and oral comprehension of the local language

Senior exclusion

- Being diagnosed mild cognitive impairment or dementia.

3.3 Participants' involvement

Recruitment

Different channels of recruitment were used to meet the inclusion criteria, such as: digital announcements on social medias like Facebook, Twitter, LinkedIn and Instagram or on official websites. We also recruited seniors and their informal caregivers by asking the formal caregivers who they think could be interested. Some flyers were installed on physical locations such as: universities, seniors' associations, councils' institutions, tea rooms, hospitals, or any other place which would like to collaborate. One should also not forget their own networks of contacts who might be interested in participating in the tests.

90 participants were required for the beta test, and with a widespread effort to meet those requirements (project dissemination, contact with several home living institutions, posters in strategic areas (Annexe D)), the number of participants were about all reached in each site. We additionally created focus groups to discuss the project and collect participants' opinions. In total, as proposed in the DoW, we included 90 participants (33 frail seniors, 31 formal caregivers, 26 informal caregivers) who either evaluated the robot in a real environment, or participated in focus groups to share perceptions, opinions, beliefs and attitudes about the robot functionality to - among others - support day structure and its social abilities. The focus groups took place in Switzerland because lots of nurses were either not allowed to take part in the study because of legal reasons, or they didn't have the time, or their patients were not matching the inclusion criterias.

Table 1. Participants' involvement per site

	Switzerland	Italy	Netherlands	Total
FS	10	10	13	33
FC	10	10	11	31
IC	10	10	6	26

End-user	Country	Sample size	Gender *(F/M)*	Age (in years *(mean ± SD)*	Educational level *(Low/Middle/ High)*	Digital skill level* *(mean ± SD)*	Devices frequently used**
Senior	NL	13	8/5	81.5 (±5.4)	(1/9/2)	3.7 (±0.8)	PC: 8 Tablet: 9 Smartphone:10
	IT	10	5/5	75.4 (±5.8)	(3/4/3)	3.3(±1.3)	PC: 5 Tablet:7 Smartphone: 10
	CH	9	2/7	*77*(±10,86)	*(4/2/3)*	*2.3* (±1.6)	*PC: 3* *Tablet: 3* *Smartphone: 6*
Informal carer	NL	6	5/1	53.5 (±2.3)	(0/2/4)	2.5 (±0.9)	PC: 4 Tablet: 3 Smartphone:5
	IT	10	5/5	47.6 (±9.7)	(1/5/4)	4.6(±0.7)	PC: 9 Tablet: 9 Smartphone: 10
	CH	10					
Formal caregiver	NL	11	8/3	40.7 (±12.8)	(0/2/9)	4.6 (±0.9)	PC: 10 Tablet: 10 Smartphone:11
	IT	10	6/4	39.3 (±13.0)	(0/2/8)	4.6 (±0.5)	PC: 9 Tablet: 9 Smartphone: 10
	CH	10					

3.3.1 Switzerland

In Switzerland, 30 end users participated in the beta testing. The challenge for recruitment was that the biggest home care institution in town doesn't work in collaboration with the HUG. To face this difficulty, we contacted freelancers or people working on other institutions, we put flyers in strategic areas (Appendix B). We also went directly in contact with frail elderly people, via a list of partners patient HUG had. Informal carers involved in the beta phase were the ones senior already had.

3.3.2 Italy

In Italy, a total of 30 end-users participated in the beta testing. End users who participated in alpha test were contacted: 3 out of 5 dyads took part also in beta test. The other end users were contacted through the INRCA hospital in Ancona and a list of people who participated in previous projects.

Unfortunately, 1 frail senior and his informal caregivers did not want to continue the test after 1 week, so we could not process their data. The dropout was due to the lack of perceived usefulness of the GUARDIAN system.

3.3.3 The Netherlands

In total, 30 end-users participated in the beta testing in the Netherlands. Participants were recruited via the care organization Zorggroep Noord-West Veluwe (ZNWV). ZNWV used their network to recruit participants as well as flyers that contained information about the GUARDIAN project (appendix C). The sample contained 13 seniors who tested the GUARDIAN system for at least one week. Not every senior had an informal caregiver that was interested in participating in the study and some couples participated who shared the same informal caregiver, resulting in a relatively low number of 6 informal caregivers that participated in the beta testing. In total 11 formal caregivers participated, who were all employees of ZNWV and visit the participating seniors regularly. See table 4 for the demographics of the participants.

3.4 Participants' demographic data

3.4.1 Switzerland

Table 2. Demographic data - Switzerland

Participants	*Numbre*	*Gender (W/M)*	*Age in years (Mean ± SD)*	*Level of education (Low/Medium /High)*	*Technological level (Mean ± SD)*	*Technological tools*
Senior	*9*	*2/7*	*77*(±10,9)	*(4/2/3)*	*2.3* (±1.6)	*PC: 3* *Tablet: 3* *Smartphone: 6*
Informal caregivers	*10*	*6/4*	*53.2*(±16.2)	*(1/5/4)*	*4* (±0.9)	*PC: 9* *Tablet: 5* *Smartphone: 10*
Formal caregivers	*10*	*7/3*	*44.3*(±14.2)	*(0/4/6)*	*4* (±0.8)	*PC: 10* *Tablet: 7* *Smartphone: 9*
Middle adulthood losing autonomy patient	*1*	*1W*	*44*	*low*	*1,86* (±1.46)	*Smartphone*

3.4.1.1 *Seniors*

To describe the population, it is important to notice that 1 participant didn't reach the age criteria, however she fitted all other criteria, including receiving home care by healthcare professionals weekly, having a normal level of technology, and French speaking. This is why in Table 2 we excluded her in

the senior part, to not bias the age, but all the other data are similar to the population. Therefore, we will incorporate their data as a senior in this report.

The group of 9 seniors consisted of 2 women and 7 men, with an average age of **77** years **(SD= 10,86).** The level of education is relatively low as we have **5** people**/ 10** who have had primary education, **2:** secondary education and **3** seniors have studied at university.

The level of technological competence of the seniors is mixed. The average level of technological literacy is: **2.3/5** with a standard deviation of **1.6**. We can conclude that generally the level is close to the average. **7/10** use their smartphones regularly, while only 3 use a tablet.

3.4.1.2 *Informal and formal Caregivers*

The group of 10 informal caregivers consisted of 6 women and 4 men. The average age was 53.2 years (SD= 16.2), their level of education was globally medium and high, as we have 1 person who received primary education, 5 medium education and 4 had high education. Their average level of technology is high, standing at 4/5 (SD = 0.9). All of them use their smartphone, 9/10 their computer and 5/10 a tablet.

The group of 10 formal caregiver consisted of 7 women and 3 men, and their average age was 44.3 (SD=14.2). They had a high level of education, 6/10 has high education, 4/10 medium education. The formal caregivers also have a high level of technology: 4 (SD= 0,8). All of them use a computer, 9/10 their smartphone.

3.4.2 Italy

Table 3. Demographics participants for Italy

End-user	Sample size	Gender *(F/M)*	Age (in years *(mean ± SD)*	Educational level *(Low/Middle/ High)*	Digital skill level* *(mean ± SD)*	Devices frequently used**
Frail Senior (FS)	10	5/5	75.4 (±5.8)	(3/4/3)	3.3 (±1.3)	N/A
Informal Carer (IC)	10	5/5	47.9 (±10.5)	(1/5/4)	4.6 (±0.7)	PC: 9 Tablet: 9 Smartphone:10
Formal Carer (FC)	10	6/4	39.3 (±13)	(0/2/8)	4.6 (±0.5)	PC: 9 Tablet: 9 Smartphone:10

* on a 5-point Likert Scale

** more than once a week

3.4.2.1 *Seniors*

The group of 10 seniors consisted of 5 females and 5 males with an average of 75.4 years (SD= 5.8). No one seniors received professional care, but they visit frequently doctors (neurologist or family doctor) at least every month. Besides, 9 seniors received informal care frequently. 7 seniors received

help by their children frequently, 3 of them used to see their children everyday. In particular, they helped them for transport and provide company to the senior.

Digital skill level

The seniors were also asked to rate their technological competence on a 5-point Likert scale. On average, seniors rated their skills between very little experience and a lot of experience with a mean of 3.3 and a standard deviation of 1.7.

3.4.2.2 *Informal and formal caregivers*

The group of 10 informal caregivers consisted of 5 females and 5 male. The average age was 47.9 years (SD= 10.5). The informal caregivers rated their technological competence on average as 4.6 (on a 5-point Likert scale, SD= 0.7). The 10 formal caregivers were 5 females and 5 males. Their average age was 39.3 years old, with a standard deviation of 13 years. The formal caregivers rated their technological competence on average as 4.6 (on a 5-point Likert scale, SD: 0.5).

At T0, the informal caregivers responded to two scales, the Zarit scale, which assesses the material and emotional burden on the primary caregiver, and the Gad-7 scale, which assesses the anxiety level of the primary caregiver. Results of these 2 scales are presented on the table 3.

A score below 20 is considered a mild "burden" for the family caregiver on the Zarit scale. A score above 7 on the Gad-7 scale indicates an anxiety disorder. As we can see from the tables, at the beginning of beta test, all informal caregivers have a mild score on the Zarit scale and do not have an anxiety disorder on the Gad-7 scale.

Table 4. Zarit and Gad-7 scores for IC in Italy

	IC_IT 1	IC_IT2	IC_IT3	IC_IT4	IC_IT5	IC_IT6	IC_IT7	IC_IT9	IC_IT10	Mean	SD
Zarit score	16	4	1	12	3	6	10	2	1	6.11	4.16
Gad-7 score	4	1	0	6	0	2	4	2	0	2	2.19

3.4.3 The Netherlands

Table 5. Demographics participants for the Netherland

End-user	**Sample size**	**Gender** *(F/M)*	**Age (in years** *(mean ± SD)*	**Educational level** *(Low/Middle/ High)*	**Digital skill level*** *(mean ± SD)*	**Devices frequently used****
FS	13	8/5	81.5 (±5.4)	(1/9/2)	3.7 (±0.8)	PC: 8 Tablet: 9 Smartphone:10
IC	6	5/1	53.5 (±2.3)	(0/2/4)	2.5 (±0.9)	PC: 4 Tablet: 3 Smartphone:5
FC	11	8/3	40.7 (±12.8)	(0/2/9)	4.6 (±0.9)	PC: 10 Tablet: 10 Smartphone:11

* on a 5-point Likert Scale

** more than once a week

Table 6. Overview testing robots

Overview testing robots

Robot	**# duration of testing (in days)** (mean [min,max])	**# Drop-outs**	**Reason drop-outs**
Misty (n=12*)	5.2 [1,7]	3	Technical issues which could not be resolved, too much noise of the ventilator
Liz (n=12*)	7 [7,7]	0	

** one participant did not want to test robot Misty and another participant did not want to test Liz.*

3.4.3.1 *Seniors*

The group of 13 seniors consisted of 8 females and 5 males with an average age of 81.5 years (SD= 5.8). Twelve of the seniors received professional care on average 5 hours per week (SD= 4.3). The other senior did not receive professional care directly for himself, but a professional caregiver visits his partner daily and asks about the health of the senior himself as well. Besides, twelve participants received informal care. In one case the informal care was provided by an acquaintance, for the other eleven participants it were their children and/or their partners who provided care. One of the seniors

only received informal care occasionally because her son lives abroad and can only visit the senior 3 to 4 times a year. See table 2 for an overview of the tasks seniors receive help with.

Digital skill level

The seniors were also asked to rate their technological competence on a 5-point Likert scale. On average, seniors rated their skills between neutral (N=3) and some experience (N=4) with a mean of 3.7 and a standard deviation of 0.8. Eight seniors indicated to use a computer every now and then (at least once a week), nine seniors make use of a tablet, and ten seniors use a smartphone regularly.

Testing the robots

In total, twelve participants tested the robot Misty. Three participants dropped out due to technical errors and were able to test Misty for one or two days. On average, participants tested the robot Misty for a duration of 5.2 days in their own home. Liz was also tested by twelve participants. All participants were able to use Liz for the seven days that were planned. There was one participant who did not want to test Misty and only wanted to test Liz. The reason for not wanting to test Misty was that the participant felt that not much had changed between the alpha en beta prototype. Additionally, there was also one participant who did not want to test Liz. No specific reason was mentioned by this participant why he did not want to test Liz. An overview of both robots, in terms of testing duration, is depicted in table 3.

Table 7. Tasks seniors receive help with

Formal care	Informal care
Personal hygiene	Administrative tasks
(un)dressing	Transport & going to appointments together
Help with medication	Help with the household
Medical check ups; cleaning stoma, measuring blood sugar and blood pressure	

3.4.3.2 *Informal and formal caregivers*

The group of 6 informal caregivers consisted of 5 females and 1 male. The average age was 53.5 years (SD=2.3). The informal caregivers rated their technological competence on average as 2.5 (on a 5-point Likert scale, S=: 0.9) The 11 formal caregivers were 8 females and 3 males. Their average age was 40.7 years old, with a standard deviation of 13.5 years. The formal caregivers rated their technological competence on average as 4.55 (on a 5-point Likert scale, SD= 0.9).

4 Beta Pilot Tests Method

The GUARDIAN system was installed at the home of a senior for two weeks, besides the corresponding formal and informal caregivers were asked to use the caregiver application during their participations. Seniors were interviewed three times: at the start, after one week, and at the end (after 2 weeks). Furthermore, they were called by phone, two days after installing the robot, to know if everything was still going well. Caregivers were interviewed two times: at the start and at the end of the test.

4.1 Procedure in Switzerland

In Switzerland, testing of the GUARDIAN system was carried out between October and December 2022 with the participation of 30 people: 10 older people, 10 formal carers and 10 informal carers.

Participants were recruited through practices and home care associations, collaboration with patient partners and also by creating recruitment posters.

Once the participants agreed to be a part of the test, we gave each senior a guide, and we also created another one for caregivers to make it as easy as possible to use the Caregiver's application.

At each installation, a demonstration of the system is given and all participants were invited to do some tests. Seniors were asked to explore and interact with the tablet in order to get used to it, and caregivers were asked to submit a couple requests from their caregiver app, the see how the senior would answer to those stimulations. Once they understood it all and practiced a bit, we would fill in the questionnaire for all participants.

Two days later, a telephone check allowed us to know the first reaction of the seniors and if we should intervene in case of difficulties or blockages. This also reassured the participants. During the whole test period, we let everyone know we were available by phone or email, and we tried to follow the activities of the participants. At the end of the two weeks, we would complete the last questionnaire as we uninstalled the robots.

During the last phase of the project, we organized 3 focus groups with a total of 11 participants: 2 seniors, 3 formal carers and 6 informal carers.

These focus groups allowed us to test all the components of the GUARDIAN system in real time, to ask questions directly to the participants, to answer them and to take notes of all their thoughts, proposals and remarks. The discussions were rich and interesting and allowed us to gather the opinions of all members and understand their expectations and needs.

Figure 2: Focus Group 2 – EVALAB

To make the focus group more dynamic, we did an activity with post it for the participants to express their opinions about best and worst features, what they appreciated the most and what they didn't,

and how much they would pay for GUARDIAN services. It was the categories we needed to make sure were talked about enough.

Figure 3: POST-IT containing the notes of the focus group participants

4.2 Italy

In Italy, beta testing took place from September to December 2022 and a total of 30 end-users participated in the study.

3 of the 10 dyads (FS + IC) participated in alpha test 6 months before. 3 FS and 2 IC participated in a demo session at INRCA YOUSE Lab (Usability Lab), where the project was illustrated, a demo of the system shown, and end users had the opportunity to shortly interact with the system.

Figure 4: Demo session at INRCA YOUSE Lab

The system was installed at end user's home in presence of both the FS and his/her IC. During the installation, any functionality was shown, and a training session (lasting about 45 minutes) provided along with a short manual.

Figure 5: A training session during installation: the senior and her formal caregiver (Ancona, Italy)

After 2 days, the robot did not work properly for 4 seniors (ID: 2, 3, 4, and 5). In particular, the connection to the internet did not work, or the robot did not talk. One senior felt frustrated because the robot did not work. Two elderly people also had difficulty understanding how to use the system. The experimenters had to intervene to re-explain how to use the system. Another senior could not use the system properly because of an earthquake that occurred during the test and forced him to leave his house. Finally, 5 seniors did not have any problems using the system, however they did not use it much because they did not have enough time or because they did not find the robot very useful.

4.3 The Netherlands

In the Netherlands, beta testing took place in October and November 2022, a total of 30 end-users participated in the study. Participating entailed that two robots (Misty and Liz) were installed at the home of a senior, both for one week. Seniors were called, by phone, two days after installing each robot to hear if everything was still going well. During the first meeting we also asked seniors some personal questions to be able to personalize the messages more. See appendix D for an overview of the questions and compliments/sayings used to make the interaction with the robot more fun and personalized.

Seniors indicated that they liked the personalized messages, containing reminders of e.g., their favourite television programmes, sports matches, local news and personal agendas. These messages were often referred to by the seniors during the interviews, often combined with a positive note. The reminders for medication could have been more personalized according to some of the seniors because they did not always fit the situation. Other aspects that could be personalized for the seniors are more about the design and size of the robots.

Both groups of caregivers were interviewed only once, at the end of the test period. The test period ought to have a duration of two weeks in which both types of robots could be tested for one week. This induced that the method of testing in the Netherlands differed from the methods that were used by project partners in Switzerland and Italy, as they used a total duration of six weeks. It was decided to test for two weeks because the study in the Netherlands contained two robots, having both robots for multiple weeks at a senior's home would increase the participant burden too much.

Figure 6. Awareness sessions with seniors, informal and formal caregivers in the Netherlands

The two robots that were involved in the study in the Netherlands were Misty and Liz. The robot Liz was added to test for differences in type of robot, in terms of interface design and interaction possibilities. The functionalities were similar. Both robots were installed at a senior's home, in random order, and after one week replaced by the other robot. Informal caregivers were invited to attend the sessions in which the robots were installed at the senior's home. During these sessions, all information

about the GUARDIAN system, containing the robot, the senior application and the caregiver application, was provided (appendix E). However, informal caregivers were not always able to attend these installation sessions. In those cases, the informal caregivers received information about the caregiver application via mail or an online meeting.

Furthermore, formal caregivers did make use of the caregiver application as well. Formal caregivers were informed about the application during an awareness session. These awareness sessions were organized since it became clear during alpha-testing that more information, before starting the testing period, is beneficial. That is, in terms of expectation management, it is wise to inform participants as best as possible about the functionalities of the robot. Hence, all three user groups were invited for these awareness sessions in July 2022. During these meetings, the (in)formal caregivers received information about the caregiver application and could test the application. Seniors were asked to try out the robots during based on predetermined tasks presented on assignment cards (Appendix F).

5 Beta Pilot Tests' results

5.1 Switzerland

5.1.1 Expected usefulness

We noticed that many older people had difficulties using the GUARDIAN system and especially the Senior application. The tablet was not appreciated by the users, although the majority managed to use it.

Holding this device was not too easy and the general technological level is rather "little experience" as the average is **2.3/5**.

Example: one Frail Senior said: *"I can't click on the touch, totally overwhelmed by this level of technology"*.

From the feedback, it can be concluded that the non-responsive design of the application and the location of certain elements such as buttons caused users to become blocked and complex, e.g.,

> *"Button ok not always easy to find"*.

In some cases, there is no back button or "Ok" confirmation button, and the senior has to press the browser arrow to go back to the previous page or the home page.

The sleep mode also caused a problem for some participants who did not have the reflex to simply press the black/grey screen to exit the mode.

For the FC and IC, the use of the Caregiver's application is simple and was tested successfully and without any difficulties: logging in via their smartphones, programming a query, consulting the dashboard: an Informal Caregiver said: *"Easy to use on a smartphone"*.

The majority of the criticisms were mainly about the design of the application and the interface which was not very ergonomic.

Among the feedback we got during the interviews:

> *"Not adapted to the small size of the tablet"*, *"Not intuitive and not clear about the recorded answers"*, or *"Too bad there is no (OK) possible to the messages"*.

5.1.1.1 *Appearance*

Many seniors like Misty's appearance: his size, his eyes, his reactions etc. And find him "friendly", "sweet" and "cute".

Another Senior has a slightly different opinion:

> *"At first I'm a bit afraid of big eyes, especially if I'm not in a very good mood I didn't want to look at him or have him look at me, but I liked him"*.

We found that almost all caregivers-formal and informal-expressed their joy at having participated in the experiment and said that the design is nice and pretty.

For an Informal Caregiver : *"Friendly appearance of the robot: eyes, mimics, sound when touched"*. Unlike a Formal Caregiver who did not like the robot's eyes too much: *"Big weird eyes!".*

5.1.1.2 *(Voice) interaction*

Some criticized the robot's voice and the way messages were transmitted and almost all the elderly interviewed wanted to interact with Misty by talking to her directly without using an intermediary: the tablet.

> *"I would have liked to talk to the robot". – S*
>
> *"We need to improve the interaction: be able to send messages by voice!" – S*

Another Senior think that the parameters available on the seniors' application to change the robot's voice or to adjust its speed are well chosen: *"It's good to be able to change the parameters, especially the voice". - S*

The feedback from the FC and IC is in line with the feedback from the seniors.

Several caregivers think that the robot lacks interaction with the seniors, that the tablet is a blockage and that there is no improvement in the communication between all members of the care network: the connection with the seniors should be made easier and more innovative by adding other functionalities to the GUARDIAN system: such as voice recognition.

> *"There should be an emergency function, which translates what the elderly person says into a message." – FC*
>
> *"If the robot works like an Alexa system with voice recognition, the system will be more interesting and effective." – IC*
>
> *"Should be more interactive with voice: make more connection." - IC*

5.1.2 User-friendliness

In the whole questionnaire, the word "tablet" was mentioned about 14 times with a negative impression:

> *"The robot is useless without the tablet". - FS*
>
> *"Not very useful and using the tablet is complicated". - FS*

The use of a tablet and an application is not adapted to the target audience: The majority of the seniors indicated that the use of a device is not appreciated: holding the tablet, keeping it charged and making sure it is connected to the network.

The general impression of the caregivers about the robot can be summarised as follows: "Cute and nice robot but without the tablet".

> *"Very average system, not easy to use a tablet every day". - FC*
>
> *"Not having a tablet so they can manage the robot by themselves". - FC*

According to them, the questions asked by the robot, the suggestions and the answers are not adapted at all and will have to be changed, for example, an **IC** said: *"The suggestions are not right! You can't tell someone who is in pain that they will be fine. You should advise them to call their carer instead".*

> *"Tablet not user friendly, not mobile, need charger several hours." - IC*

Some indicated that the Caregiver's app is not intuitive and not well suited to the smartphone: text too small, not suitable for visually impaired etc. One IC said: *"I can't get out of the page with the programmed queries, you have to add a cross to get out of this page!"*

> *"It should become a real application with a better interface". - IC*

- **Seniors**

Colour shades:

1
2
3
4
5
6
7

*Globally, Seniors liked and found the robot quite easy to use. However, they were more disappointed about the actual capacities of the robot***Quality issue: usability & user-friendliness (1 to 7)**	**Average**
It was easy/simple to use the robot	5,1
I feel comfortable using the robot.	4,9
The robot [...] has all the features and capabilities I expected	2,5
The robot has an influence on me	1,8
The user guide was clear	5,6
The robot interface was easy to use	4
The interface was clear and pleasant: buttons, text, colours etc.	4,4
The information given about the robot [...] was easy to understand.	5,3
The robot [...] is important to me personally.	3,1
The robot has enabled me to communicate better with my carer and/or family carer.	3,4

Table 8. Quality issues FS

About the specific help the system wanted to bring, it seems that it doesn't truly achieve what is meant to, but it shows that Seniors are feeling quite confident with the system.

Impact of the questionnaire	**Average**
Using GUARDIAN helps me to take my medication on time.	2
Using GUARDIAN helps me to eat/drink enough	1,9
GUARDIAN reassures me.	3,5
GUARDIAN makes me feel less alone.	3,6
GUARDIAN helps me to feel more independent.	1,9
GUARDIAN strengthens the cooperation between all caregivers (informal and formal).	3
I feel confident using a system like GUARDIAN	4,6
Overall, I am satisfied with the system	4,3

Table 9. Impact of the questionnaire FS

- **FCs:**

Colour shades:

1
2
3
4
5

Formal Caregivers have mixed feelings concerning the help the robot could bring for their jobs

Impact of the questionnaire (1 à 5)	**Average**
Using GUARDIAN helps me perceive at an early stage that something is wrong with my patient.	3
GUARDIAN reassures me.	3
GUARDIAN helps me become more involved in my patients' care.	3,2
GUARDIAN helps me feel more egalitarian in the conversation with a caregiver.	2,4
GUARDIAN strengthens cooperation between all carers (informal and formal).	3,1
Overall, I am satisfied with the system **(Scale 1 to 7)**	4

Table 10. Impact of the questionnaire FC

- **ICs:**

*Informal Caregivers improved a little bit their involvement with the help of the system, although it doesn't totally reassure them about their senior's security.***Impact du questionnaire**	**Moyenne**
Using GUARDIAN helps me perceive at an early stage that something is wrong with my patient.	2,9
GUARDIAN reassures me.	3,22
GUARDIAN helps me become more involved in my patients' care.	3,75
GUARDIAN helps me feel more egalitarian in the conversation with a caregiver.	3
GUARDIAN strengthens cooperation between all carers (informal and formal).	4
Overall, I am satisfied with the system **(Scale 1 to 7)**	4,2

Table 11. Impact of the questionnaire IC

5.1.3 Interaction and personalization

5.1.3.1 *Persuasiveness*

According to the feedback, the robot has no influence on the elderly, scoring at 1.8 on the item "the robot has an influence on me" from the Quality issue questionnaire:

After testing the system for a fortnight, most of them found that the system did not really meet their expectations and did not convince them:

> *"Not enough of a tool"- S*
>
> *"I expected more, it is a disappointment. I am happy to have participated in the experiment but the system is not sophisticated enough". - S*

Carers also indicated that there was no change in their work or relationship with their relative through the GUARDIAN system, and some were forced to call the senior to make sure they had received their message or request.

We also noted that there is some certainty among FCs that the robot will be **very useful in reminding** seniors of their appointments and medications, as it saves them from calling every day and not bothering the older users. It is also clear that the robot can **reduce the loneliness** of its users, because over time you get used to having Misty at home and you are not alone.

5.1.3.2 *Interaction*

In its current state, interaction with the robot is fun, and the seniors find the exchange with Misty dole.

> *"Perfect robot, reacts when touched" - IC*

On the other hand, the programmed responses on the senior application (suggestions) are sometimes useless and should be improved according to the participants, for example, the response of the robot after reporting its well-being: *"It will be better tomorrow"*. It will be necessary to propose activities, call a relative/nurse or the doctor, propose to listen to music etc.

> *"Always the same questions, no feedback on messages, lack of relevant questions." - S*
>
> *"It will be interesting if the robot asks the wellbeing questions itself for example every morning, if the person has to remember to go and make the robot talk: it's not sure if they think about it all the time." - IC*
>
> *"When we report that we are not well, let him say : I heard your discomfort, tell me again if it is changing" - IC*

5.1.3.3 *Personalization*

Many suggestions were made to personalise the robot and make it more responsive to expectations, including: a search engine, the possibility of making video calls through the robot, better presentation of appointments, and possibility for seniors to add things themselves.

The seniors prefer the robot to speak to them by their first names only.

One Senior mentioned he would like to have a light on the robot to know if we have a new message/reminder or not. He added that he would prefer to be able to insert appointments or information about medication himself. These features allow for a personal database.

> *"With the agreement of the participants, I propose to make a map of the place where the robot can move (like the hoovers) so that it can move and "look" for where the senior is." - IC*

The Informal Caregiveralso indicated that it would be fun to add games to the Senior app.

An informal Caregiver wondered: *"Is it really different from a phone? Can the robot have more personality?" - IC*

The participant suggested putting cryptograms instead of questions, and making the interface friendlier.

5.1.3.4 *Social connectedness*

In general, the majority of the seniors find that Misty can keep them company and be considered a member of the family and a **remedy for loneliness**. We found that some participants were used to having the robot in their homes and said they would miss it.

The FCs and ICs noted that Misty is good company and that her presence has created a certain habit among the patients. Two formal caregivers reported a fear that the robot would replace human contact and lead to a loss of social ties: *"Not sure a robot can make you feel less lonely".* In contrast to the others, who think that this system can strengthen the contact with their patients and allows for more regular follow-up every day: *"The robot has made him company"*.

5.1.4 Responsible Innovation

5.1.4.1 *Privacy*

Most of the seniors feel safe when they were at home and felt that their privacy was respected and that Misty did not pose any risk. A few did some remarks about the camera and microphone and expressed their discomfort: feeling watched, feeling stressed and doubting whether the robot is recording or not.

> *"Is it filming?" - S*

All caregivers expressed confidence in the GUARDIAN system and the robot, except for a few:

> *"Uncomfortable with the camera, I feel watched, a bit stressful not knowing if it is really not recording, I prefer to put my back to the robot so I don't feel spied on". - FC*

For one Informal Caregiver the only concern is about the fire, if the robot overheats. For some caregivers, the main concern was about the private life of the senior, and the risk it could be endangered with the ad of features like cameras, and microphones open. If the data is not protected correctly, they could be spied on.

5.1.4.2 *Feeling of control and trust*

For the question asked on the feeling of confidence: *"I feel confident when using a system like GUARDIAN",* the average response of the seniors is: **4.6/7**. From this we can conclude that the majority feel confident.

The same goes for carers:

> *"I don't feel embarrassed using GUARDIAN and I feel confident about it." - IC*

5.1.4.3 *Willingness to pay*

For payment, we present these two tables: the first one concerns the willingness to pay per month to have the GUARDIAN system, and the second one for the willingness to pay at once.

1/3 of the participants were willing to pay €25/month or more for the system.

For the purchase of the system, there is a balance between those who do not want to pay and want the insurance to take care of it, those who pay between €100 and €1000 and those who are willing to pay more than €1000. It can only be noted that out of 10 seniors, 7 answered €0 or another answer, such as:

> *"The insurance should help" - S*
>
> *"It will have to be fully covered by the health insurance". - S "If the purchase is not reimbursed by the insurance, then a remote alarm will be cheaper and more effective." -S*

Almost all carers also indicated that there would have to be a contribution from health insurance or the state: 50/50 or even full coverage.

One Informal Caregiver liked the idea of being able to rent the robot:

> *"As the elderly person doesn't know for how long he/she would need it, so he/she prefers to rent the robot Misty." -IC*

Willingness to pay/month	Senior	Informal caregiver	Formal caregiver
€0,-	2	1	2
€5,-	-	-	-
€10,-	-	1	1
€15,-	2	1	2
€25,-	3	2	4
Else	1 (€35)	3	1
Not able to answer	2	2	-

Table 12. Willingness to pay in Switzerland per month

Willingness to pay (buy)	Senior	Informal caregiver	Formal caregiver
€0,-	3	1	2
]€0 - €100]	-	1	3
[€101 - €500]	1	2	2
[€501 - €1000]	1	3	-
> €1000,-	1	2	2
Not able to answer	4	1	1

Table 13. Willingness to pay in Switzerland for once

5.1.5 Positive aspects & points for improvement

	Positive aspects	Points for improvement
Misty	• Design/appearance of the robot • Does not take up much space • Friendly and cute robot • Funny reaction by voice/eyes • Keeps company	• The noise of the robot especially when it is charging. • There is no stability: from time to time the robot does not work properly and does not receive requests • Not suitable for voice recognition
Senior Application	• Doesn't require a lot of technological experience: simplicity • Interesting features according to many seniors • Indicators on the robot and the application are useful to know if you are well connected	• Reconnexion complicated for seniors in case of disconnection from the application • Remove the tablet and use another technology • The tablet must be on and charging all the time: putting it on standby disconnects the application. • The design: some pages do not contain a "back" or "Ok" button. • Cannot be used if the senior does not have Wi-Fi at home • Question and answer suggestions were strongly criticized • Senior citizens cannot answer the queries received • View one week's appointments
Caregiver Application	• Simple for Caregivers: interface and use • History of features used by the senior • Be able to send private messages • Insert senior's appointments	• We can't know if the senior has received our message/query: add a feature to confirm reception. • Reminders/notifications do not work • Add more features
GUARDIAN System in total	• Interesting and important system/project • With improvements, GUARDIAN will be able to help many patients, especially those who live alone • There is a certain acceptance to pay for the GUARDIAN service, whether to rent the robot or to buy it.	• Thinking more about improving the interaction between the seniors and the different tools, as well as the communication with the care network. • Use advanced technologies such as voice recognition to meet the expectations of the target audience and think about the general level of mastery of technological tools.

Table 14. Positive aspects & points for improvement in Switzerland

5.1.5.1 *General functionalities and concept*

The proposed features were all tested and generally liked. Some suggested adding other features such as the possibility of inserting appointments, and the same for medicines. Being able to communicate with the robot via voice recognition is a feature that was very much requested by all the interviewees. They think that the use of the tablet destroys the importance of Misty and makes the whole system useless.

During the focus groups, we noticed that sometimes the seniors do not receive the programmed requests. Some participants suggested adding a validation/confirmation option for receiving a message or reminder.

Speaking about the technical defects of the robot: *"A lot of noise", "Too noisy"*... these sentences were repeated several times by the seniors, and they affirmed that they had to switch off the robot to be able to sleep or because they were bothered by the unbearable noise, especially in the evening.

A good part of the users could not use Misty during the whole test period (2 weeks) because of a malfunction of the robot or a disconnection of the Senior App...

All features were appreciated and considered interesting with some important suggestions: Several caregivers indicated that the requests sent are one-way, as the elderly person cannot act and respond when receiving a request which poses a problem of follow-up: *"We don't know if the patient has received the request"*, *"The obligation to make a phone call to find out if the request has been received".*

One proposal was to add a "reply" option on the Senior application, either by text or voice message. Another participant suggested adding an "Acknowledgement of receipt" feature. There was also a suggestion to add a light on the robot that lights up when a message is received. All these remarks indicate that the current functions are not sufficient to have an ideal exchange between the nurse and his patient, and the proposals were focused on the Senior application: Add a pain functionality with intensity, a fall detector, an "emergency" function that transcribes what the elderly person has said, listen to music, a "mood" option etc.

> *"For appointments: although they don't fade away, it allows you to have a record of what has been done." - IC*

One participant suggested adding a feature that allows emergency calls to relatives or the medical network.

Most informal carers did not know if the senior received their messages. They used the application mainly to send my personalised messages, set reminders and also to add appointments for their relatives.

5.2 Italy

5.2.1 Expected usefulness

Overall, caregivers found the system useful primarily for **medication reminders and appointments**. In addition, 2 ICs found the system to be a stimulus for the FS to be more active. Two seniors had difficulty using the system.

> *"I didn't understand how it works and if it works"- S*

2 seniors found that the system didn't work well, and didn't remind them to take their medications and their appointments. Their informal caregivers observed the same problem for the reminder. The problem encountered frustrated and stressed the participants.

> *"There are still a lot of things to be fixed, the fact that it doesn't work very well is frustrating and makes it not be used" – IC*
>
> *"A negative influence, I feel stressed because Misty doesn't work" - FS*
>
> *"It has a negative influence because I would like to use it, however there are some things that don't work, so I stop trying" - FS*

The feature that was most appreciated by participants was the medication reminder for 2 FSs, 7 ICs, and 4 FCs. Often ICs also found the functionality to add appointments to be very useful. FCs found the medication reminder and sleep features to be the most useful. One of the seniors liked this feature but she could not hear the robot when there was a reminder, so she preferred to set an alarm on her phone.

However, informal and formal caregivers would have liked the FS to be able to enter their own appointments and for the robot to automatically remind them.

The deliverable is well balanced in pros & cons. Very well!

> *"Should be given the ability for the elderly person to be able to enter appointments themselves and for the robot to remember appointments by itself". – IC*
>
> *"Useless, even the medication function which should be the most important one, is useless. I have a big house, I can't hear it from one room to another, so I'd rather put an alarm clock on my cell phone to remind me of medication" – FS*

Some FCs and one IC expressed their disappointment and would have appreciated more functionality. They expressed they would have like an automatic reminder of appointments from the robot, without the use of the tablet. One FS expected the system to have more medical information such as who to call when they have a medical concern, as medication reminders can be done on the phone. One IC also indicated that it would have been interesting to add cognitive and memory activities to better stimulate people with dementia like his mom. A FC also indicated that it would be interesting to have more information about the senior's physical activity.

> *"More or less, maybe I was expecting more features" – FC*
>
> *"The robot is nice, but it is essential that medications and appointments, once marked on the tablet, he remembers them himself. If the user has to go to the tablet to look them up it becomes quite useless." - IC*
>
> *"I would add something related to the sphere of health, remembering medicines is not enough, even the alarm clock on the cell phone does that. For example information about medicines, or who I need to call to book that particular visit." - FS*

"Certainly it is a help, but it is not essential, I could do the same things on my own" - FS

"the robot can increase the older person's capacity and ability to take care of itself, including adding cognitive/memory activities." - IC

"I think that the app have to give me more information about the physical activity of the senior" - FC

Seniors expressed that this robot could also be useful for people who are frailer than they are.

" It is important in the sense that it keeps me busy and stimulated, but I realize that perhaps it would be more useful for a person who is less independent than I am" - FS

"I use it, however I think for a person like me it is not very suitable, I am still too autonomous and independent" - FS

Unfortunately, the FSs did not see much interest in integrating it into home care as the system is today. For them, the system would need to have more parameters, like adding physiological parameter detection or calling an emergency system. The system was rather seen as useful for elderly people who don't have so many people to take care of them.

"it should be supplemented with something that could, for example, detect physiological parameters, or keep the person in contact with an emergency system" - FS

"maybe it would be useful for those who don't have anyone to take care of him" - FS

According to caregivers, the GUARDIAN system could not yet support in the care for the elderly. They said they prefer to be called, mentioned the system is not useful enough for them as it is or that it could be done more simply by other means. Others, however, recognized the usefulness of the system, especially for sending messages to FS. For Formal caregivers, having an overview of the patients is useful and the information collected can allow for better triage to know who to prioritize. Some FCs also expressed that the system could save them time and that it would probably be more useful if they could test it on more patients at the same time.

"I can say that it is not so fundamental. My workload would not change; in fact, maybe it would increase slightly. Certainly it would be good to have an overview of all patients, especially with regard to medications, although I would not rely on GUARDIAN alone." - FC

"I find it useful in its simplicity, it could be used to check all patients and then prioritize the more serious ones" - FC

"I couldn't say. Certainly using it with many patients makes more sense than using it with a low number of patients. Maybe in this case I would be able to understand its potential." - FC

The FSs did not think that the robot could increase their autonomy and independence. 2 FS mentioned that the robot could improve autonomy but only if it was improved and worked properly.

"It could be useful for improving people's autonomy, but it should work perfectly" - FS

The ICs did not feel that the system could help them provide better care for their loved one, with the exception of 2 FSs.

Overall, the participants would like to see improvements of the system, as can be seen with the questionnaire averages which are all below average. The FS thought that the robot did not have the expected functionality yet (M=3.67, SD= 1.5) and were therefore not sufficiently satisfied (M=3.44, SD=2.19). The system was missing some functionalities to be really useful and a companion. Other systems exist for reminding people of medications and appointments that are simpler. They would have liked to be able to communicate with the robot directly without the tablet. The noise was also somewhat annoying so having a better battery would have been useful. But also to be able to add by themselves the appointments. But they enjoyed using it.

> *"No, an elderly person needs companionship, which unfortunately cannot be given by a robot." - FS*
>
> *"Well, let's just say I would have liked it to have more functions. First, that I could talk to him directly, without a tablet, then I would have liked to be able to enter appointments and medications independently" - FS*
>
> *"In my opinion misty has potential, he is nice and cute and for those who live alone he can also seem to have company. I think if he spontaneously remembered appointments and improved his speech a little bit he could already be better...." - IC*
>
> *"I expected better. First of all, I thought it worked better, but even if it had worked all right, the functionality was too simple and basic" - FS*

Table 15. Impact survey with FS one week after the installation (T1) and 2 weeks after the installation (T2) in Italy

Impact survey with FS				
	Mean T1 (n=9)*	**SD T1 (=9)**	**Mean T2 (n=9)***	**SD (T2 (n=9)**
Robot [...] has all the features and capabilities I expected	3.25	1.57	3.67	1.5
Robot [...] has an influence on me	2.13	1.65	2.56	1.59
Robot [...] is important to me personally	2	1.65	2.56	1.67
Robot [...] makes me reconsider certain habits such as my diet, exercise pattern or medication intake	1.62	1.41	2.22	1.48
Overall, I am satisfied with robot [...]	2.5	2.13	3.44	2.19

**Linkert scale 1 to 7*

5.2.1.1 *Appearance*

About the robot appearance, seniors found the robot very nice, sweet and cute.

> *"surely the robot chosen is perfect aesthetically, because it is very cute" –FS*

Some formal caregivers did not really like the design of their website interface, 4 FCs expressed that one of the negative points of the system was the design of the interface.

Some participants found the system too bulky and noisy sayingthe robot makes a loud fan noise when it charges. They understood it had a short autonomy, and therefore had to be permanently charging to be sure not to miss a reminder.

5.2.1.2 *(voice) interaction*

The majority of participants used the system every day. Some participants, however, used it less and less often because the robot did not work well for them.

Some seniors appreciated the fact that the robot was **like a companion**, and that it kept them company. Other participants regretted the **lack of interaction** of the robot, mainly because they could not answer to it by voice, which they'd like.

> *"It was pleasant, it kept me company" -FS*
>
> *"Maybe it would have been better to be able to respond verbally instead of using the tablet, it all seemed complicated to me" - FS*
>
> *"Perhaps something could still be added, such as the ability to talk to the robot, without using the tablet, or ask for some general information" -FS*

The FS said they were strictly following the instructions to respond to the reminder when they received them However, many had problems and did not receive the reminders.

5.2.2 User-friendliness

The table below shows the results with scores based on a 7 point-scale [1: totally agree; 7: totally disagree].

The system was considered as useful, the seniors gave it a mean of 3, and the informal caregivers 2.7 and formal caregivers 2.6.

The quality of the information provided was judged acceptable with averages around 3, which means that they judged the system as not providing clear information to find the information. The FSs liked the interface very much as they considered it pleasant (M=1.77, SD= 0.67), and did liked using it (M=2.66, SD= 1.50). On the other hand, they felt that the interface could be improved with further functionalities (M=4.11, SD=1.62).

Table 16. IBM questionnaire with all participants in Italy (1 represents a positive score, 7 negative)

IBM questionnaire						
	FS (n=9)		IC(n=9)		FC(n=8)	
	Mean	SD	Mean	SD	Mean	SD
Overall, I am satisfied with how easy it is to use the GUARDIAN system.	2.89	1,27	2,67	1,58	2,11	0,93
It was simple to use the GUARDIAN system.	2.89	1,27	2,67	1,58	2,67	1,41
I could (effectively) successfully complete the tasks and scenarios using the GUARDIAN system.	3.44	1,88	3,00	1,87	2,56	1,33
I was able to complete the tasks and scenarios quickly using the GUARDIAN system.	3.22	1,79	2,78	1,99	2,56	1,33
I was able to efficiently (quickly) complete the tasks and scenarios using the GUARDIAN system.	3.22	1,79	2,78	1,99	2,56	1,33
I feel comfortable using the GUARDIAN system.	1.89	0,78	2,11	1,05	2,44	1,59
It was easy to learn to use the GUARDIAN system.	2.56	1,01	2,22	1,64	2,89	1,90
I believe I could become productive quickly using the GUARDIAN system.	4	1,32	3,89	2,47	3,22	1,30
System usefullness	3,01	0,63	2,76	0,54	2,63	0,32

The GUARDIAN system gave error messages that clearly told me how to fix problems.	6.44	0,73	5,63	2,00	5,44	1,67
Whenever I made a mistake using the GUARDIAN system, I could recover easily and quickly.	4.44	1,42	3,00	2,00	3,00	1,73
The information (such as online help, on-screen messages, and other documentation) provided with the GUARDIAN system was clear.	3.56	1,81	2,33	0,87	2,89	1,62
It was easy to find the information I needed.	2.44	0,88	2,33	1,00	2,56	1,51
The information provided for the GUARDIAN system was easy to understand.	1.89	0,78				
The information was effective in helping me complete the tasks and scenarios.	2.67	0,87	1,78	0,97	2,22	0,97
The organisation of information on the GUARDIAN system screens was clear.	1.67	0,50	3,22	1,20	4,11	1,27
Information Quality	3,30	1,69	3,05	0,52	3,37	1,20
The interface of the GUARDIAN system was pleasant.	1.77	0,67	3,67	1,00	4,33	1,32
I liked using the interface of the GUARDIAN system.	2.66	1,50	3,22	1,20	4,11	1,27
This GUARDIAN system has all the functions and capabilities I expect it to have.	4.11	1,62	4,56	1,74	3,44	1,81
Interface quality	2,85	1,18	3,81	0,68	3,96	0,38
Overall, I am satisfied with the GUARDIAN system.	5.56	0,88	4,33	1,80	3,00	1,00

The robot

There were some problems with the robot, internet was easily disconnected, reminders were not always received, which frustrated the participants and discouraged them to continue using the system. One FS had problems with the "wake up" button to put the robot to sleep and wake it up, after pressing it he could not wake it up. To solve all these problems, they called the experimenters who were able to come on site to debug the system and re-explain its operation.

> *"I would gladly use it, however unfortunately the robot doesn't talk and doesn't give reminders" – FS*

> *"The last few days the system was upgraded, it actually worked better, but disconnected from the internet very often" - FS*

One of the good points highlighted is the fact that the buttons and the test on the tablet was large and clear.

> *"Easy to use, the writing on the tablet is large and clear." - FS*

Overall the FSs found the robot to be moderately easy to use with averages around 4 for ease of use, but these averages went up a bit after using it for a week. This is probably due to the fact that the robots had at first bugs that could be fixed for the second week of use. They also found the robot's interface very pleasant with averages above 5. Finally, despite their positive appreciation of the interface, they did not enjoy using the robot very much with an average below 5. The explanation may come from the fact that the robots had some technical problems.

Table 17. Usability survey with FS at T1 and T2 in Italy (1 represents a negative score, 7 a positive)

Usability survey with FS at T1 and T2				
	Mean T1 (n=9)*	**SD T1 (=9)**	**Mean T2 (n=9)**	**SD (T2 (n=9)**
It was easy to use robot	4.13	1.36	4.78	2.49
I feel comfortable while using robot	4.25	2.21	4.67	2.40
It was easy to learn it how to use robot	4.75	2.21	5	1.73
The given information about robot was easy to understand	5	2.21	6	1.73
The interface of robot [...] was pleasant.	5.88	0.94	6.44	0.88
I liked to use robot	3.75	1.81	4.11	2.15

*Linkert scale 1 to 7

The caregiver app

Caregivers found the app **easy to use** and intuitive except for two FCs who found the system a little bit difficult for them to use and needed some more explanations. When participants were asked what they liked best, the answer that stood out the most was its ease of use. One FC found the caregiver app better on PC than on smartphone. The interface could be improved graphically for four FCs. One FC found that the smartphone version had some issues (with translation for example), and the message function didn't always work but it will be very useful. 4 participants found the system difficult because it necessitates a lot of state to enter a reminder, and the procedure was judged too long.

> *"The interface is better from a pc than from a smartphone. It would be more convenient to be able to install an app on the device rather than accessing the web page every time"- FC*
>
> *"The smartphone version had some critical issues (translation and more). The message function would be very useful if it worked" – FC*
>
> *"I found it a little bit difficult to use, I am not very computer literate, it took me a while to figure out how to move around within the application" – FC*
>
> *"It would have been easier if there were fewer steps to enter reminders" – FC*
>
> *"it would be faster to do the same things but manually" - FC*
>
> *"The mobile version is not good, not intuitive, I have to put one reminder for each somministration of same medicine" - FC*

5.2.3 Interaction and personalization

5.2.3.1 *Persuasiveness*

The FSs explained they felt stressed and frustrated by the robot not working as good as they thought. One of the ICs noted that the system was helpful in getting the FS to think about drinking more water, however he thought that the behavior would not necessarily continue once the system was removed. The ICs also noticed that the robot kept company to the seniors and that they enjoyed using it. The FCs did not know for sure, but in their opinion the system did not really influence the seniors.

> *"the robot was not working, so my mom is getting stressed and frustrated. She wants to abandon the experiment" - IC*

"My partner really enjoyed it, found it useful and interesting" - IC

"Influenced in the sense that at the time of the water reminder he would actually drink a glass of water. Otherwise, no." - IC

According to the caregivers, GUARDIAN didn't change the seniors' habits. . They were already well organized, so the robot did not have that purpose in thoses cases, except for one who drank more water thanks to the system. Some FCs indicated that it might change them.

"She has always been very organized and precise, she has a calendar in which she marks everything, so she would have remembered her medications even without Misty. With GUARDIAN, though, she had extra security." - IC

"No because the robot did not give directions on this type." - IC

"I think he considered drinking water when he was reminded but I don't think the system affected his habits permanently" - IC

It can be noticed that indeed the system did not have sufficient impact on the seniors, they evaluated the impact of the system on their life with below average scores for all of them, except for the medication which had an average score (M=2.56, SD=1.42). This can be explained by the fact that this feature was perceived as a really useful functionality by the users.

Table 18. Persuasiveness questionnaire with FS in Italy

Persuasiveness questionnaire wqith FS		
	FS (n=9)	
	Mean*	**SD**
Using a system like GUARDIAN (the robot along with the app) helps me take my medication on time	2.56	1.42
Using a system like GUARDIAN encourages me to be more active	1.56	0.72
Using system like GUARDIAN helps me eat and/or drink enough	1.56	1.01
Using system like GUARDIAN makes me less lonely	1.89	1.45
Using system like GUARDIAN makes me more independent	1.56	0.73
A system like GUARDIAN helps me have a daily routine	1.78	1.09
A system like GUARDIAN helps me inform my caregivers about my well-being	2	1.11
Using a system like GUARDIAN makes me feel safer	1.78	0.97
I feel confident while using a system like GUARDIAN	3.44	0.53
Overall, I am satisfied with the GUARDIAN system (the robot & app)	3	1.73

*Likert Scale 1 to 5

ICs did not find the system had a particular impact on them, with averages below average. However, FCs thought the system helped them care for their patient and also helped them perceive if something was wrong (M=3, SD= 0.67).

Table 29. Persuasive survey with caregivers in Italy

Persuasive survey with caregivers				
	IC (n=9)		FC (n=10)	
	Mean*	SD	Mean*	SD
Using GUARDIAN helps me to perceive at an early stage that something is going wrong with my loved one / patient	2.22	1.20	3.4	0.67
GUARDIAN brings me reassurance	2.22	1.20	3	0.47
GUARDIAN helps me to be more involved in caring for my loved one /patient	2.11	1.05	3	0.67
GUARDIAN helps me feel more equal in conversation with a professional caregiver /caregiver	1.78	0.67	1.7	0.82
GUARDIAN strengthens cooperation between all carers (informal and formal)	2.22	1.20	1.8	0.79

*Likert Scale 1 to 5

5.2.3.2 *Interaction*

Participants pointed the Lack of interaction possibilities with the robot. One elderly person thought it was a pitty that they could not interact with the robot as they were hoping for more dialogue or reaction from the robot. 2 FS did not interact with it, considering it as an object such as a smartphone. Most seniors did not really feel the interaction with the robot and have tended to consider it more like a gadget.

> *"I would like to be able to have more companionship, to be able to have simple dialogues with Misty" - S*

> *"It is definitely something fun and quite useful, but I don't feel a real interaction" - FS*

5.2.3.3 *Personnalisation*

The FSs felt that the system did not truly fit their own situation. One FS would have preferred to have more social functionality than recall functionality. Two FS also indicated that they would have preferred to have a bit more possibilities. One FS insisted that appointments should be automatically reminded, to be sure it is not forgotten. Another FS mentioned that prior to the test with the system he already used his phone for medication reminders, therefore, did not engage in using this functionality with the guardian system.

> *"I can still remember everything by myself, so I would have preferred a companion function more than a reminder function"- FS*

> *"I have my cell phone reminding me of the medication I need to take, why should I use a robot?" -FS*

Six ICs felt that the system was not appropriate for the FS. One of the ICs would have liked the FS to be able to enter her own medication and appointment reminders and talk to the tablet. One FC commented that also being able to choose the day and time for appointments and messages, they

would like even more possibilities to reach everything they need. Another FC felt that the system could have more features to fit their needs.

> *"I think it could be more customizable. First of all, I would like the elderly person to be able to enter medicines and appointments independently, to be able to talk to them without using the tablet, and also to be able to ask for general knowledge notions, for example" - IC*

> *"Other than changing the times and days, nothing else can be done to customize the robot. There is something missing in my opinion." - FC*

5.2.3.4 *Social connectedness*

ICs found that the system did not change the contact they had with their FS. One IC indicated that it changed in a way of better monitor the activities of the FS. Also, some FS see their family every day, so because of that reason the robot is not of added functionality in communication. A FS mentioned her phone and Skype as the way of communication she was already using, therefore she didn't use the robot for the communication purpose. The preferred solution is still to call if there is a problem.

> *"It does not seem to me that anything has changed except a greater ability to control the daily activities performed" - IC*

> *"In Italy, I don't know if it could have this effect, especially in small towns. For us the value of family is important, there is no day when I don't hear or see my son for example. With us caregivers and the elderly are always in contact" - FS*

> *"I don't know, anyway we all have cell phone, tablet, skype now, I don't think a robot can do anything more" - FS*

> *"if I have to communicate with family members about something concerning the patient, I prefer a phone call" - FC*

The FCs also felt that the system had not much changed the contact they had with the FS. Some remarked that the system did not have that purpose for them but more to monitor their patient's health. One FC changed his interactions by calling the IC more often. Another FC mentioned the fact that they could send a message to the FS but not receive a response back. To improve this point and the communication between caregivers and seniors it would be interesting to add more functionalities such as having the FS respond to personal messages, having the FS send messages, adding a live chat, a microphone system to talk with the caregiver.

> *"I would not use this app for this purpose, but only to check the health status of my patient" - FC*

> *"I can send a message to the senior but the senior cannot answer me" - FC*

> *"It might if more functions were implemented, such as a direct chat" - FC*

> *"I would not use this system, if I have to communicate with family members about something concerning the patient, I prefer a phone call" - FC*

> *"Maybe a microphone so I can talk to my mom." - IC*

Finally, the system had a positive effect on an FS with dementia, according to her and her daughter the system stimulated her by keeping her busy, and increased her ability to care for herself.

> *"My mother has severe dementia, and sometimes I find it difficult to have contact with her. I have noticed that since we have Misty she is more stimulated, although obviously the system is not for her, but it has had an indirect effect on her well-being as well" - IC*

> *"the robot can increase the older person's capacity and ability to take care of itself, including adding congnitive/memory activities." - IC*

5.2.4 Responsable Innovation

5.2.4.1 *Privacy*

All participants have no concerns about data privacy. Some people think that nowadays, if you use new technologies like a smartphone, you should not be too careful about the privacy of your data. But for this project, they don't have any concerns either for themselves or for their loved ones. They think that the privacy is well respected.

> *"For privacy no problem, now our data is everywhere, we should not even use our cell phones to be safe. As for privacy now our data is everywhere, if we want to use these technological things we have to know, so no problem" - FS*

5.2.4.2 *Feeling of control and trust*

All FSs have the feeling that they have control over the GUARDIAN system and trust it. In addition, no caregiver saw any risk in using this system.

> *"Yes absolutely, I am the one who decides when and what to report to the robot " FS*

The FS did not feel safer with the robot than before.

> *"I don't feel safe, but I don't feel in danger either. I don't think it can have an influence on this dimension." - FS*

5.2.4.3 *Willingness to pay*

Participants were asked to indicate how much they would be willing to pay per month to use the GUARDIAN system. The FS were more willing to pay for the robot, almost all giving a price above 0€ per month. The IC and FC were more mixed, with 3 IC and 4 FC not willing to pay for the system. However, 2 IC indicated that they would be willing to pay around 100€ per month to use it if the system was improved.

> *"100 euros per month. In its current state I would not pay. If it improved in interaction and if I really needed it maybe I would pay up to 100 per month" - IC*

Table 19. Willingness to pay for FS in Italy

Willingness to pay	Senior	Informal caregiver	Formal caregiver
€0,-	2	3	4
€5,-	2	x	4
€10,-	3	2	1
€15,-	2	1	x
€25,-	x	x	x
Else	x	2 (€100)	x
Not able to answer	x	x	1

The FS estimated the price of the system around 1000€ for 3 seniors, the others did not know or indicated prices between 10 and 100€ per month. The ICs thought that the system would become too expensive to be purchased from 2000€ for one IC, from 100€ per month for two others, and from 30€ per month for 2 others.

At the current state, FS were not willing to pay for this system but they would be if the system was improved with the addition of features like being able to communicate vocally with the robot, having medical info or if they were more in loss of autonomy.

All participants are very supportive of research in general and see the value of this research in improving the quality of life of patients and caregivers. It is important for them that money is invested in these kind of projects, even if some participants were somewhat disappointed that the system developed did not have more functionality.

> *"Absolutely, it is worth investing time and money in technological research to find better and better solutions. I also believe it is crucial to put effort into understanding how to use these systems, because they are a way to stay cognitively active and stimulated" - FS*

> *"I think it is worth investing in this kind of project, I think it can be a facilitator between society and the elderly, so it would be worth investing time and money. Not in this specific project though, it has too simple functions" - FS*

> *"Yes, it is essential to invest in technologies that improve the quality of life for the patient and caregiver. If the technology reduces the caregiver's workload, it is worthwhile to invest time and energy in teaching how these technologies work." - FC*

Participants were not sure how the system could be funded. ICs did not know because the system was not working sufficiently well and they did not want to personally fund it. FCs did not know because they think the family should fund it. Participants did not think that the system would be reimbursed by insurance, they thought it would be nice but as it stands now it does not have enough functionality for insurance to agree to reimburse this kind of system which is not a medical system.

> *"I think the patient's family should be the one to pay for such a system, so I don't realize how much it might cost" - FC*

> *"I don't think they would, it's not a medical system" - FS*

> *"No, it does not have enough functions to be funded" - FS*

> *"No, it is not complete enough, it would not be funded" - IC*

5.2.5 Positive aspects & points for improvement

Table 20. Positive aspects and points for improvement

	Points for improvement	Positive aspects
Misty	Too Noisy	Cute
	Low battery	
	Answer vocal	
GUARDIAN system in total	Add chat	Easy to use
	FS can respond to messages	Nice and pleasant
	FS can send messages	Medication reminder
	be able to answer with the tablet and not have to use the tablet anymore	
	FS can add appointment and reminder	
	automatic reminder of appointments	
	Add medical information	
	Add cognitive activity for FS	
	Add physical activity of the FS	
	Connection bug	
Caregiver app	improve the graphic interface of the caregiver app	Ease to use

5.3 The Netherlands

5.3.1 Expected usefulness

Most of the senior participants had no real expectations of how GUARDIAN could be of use to them. 2 seniors mentioned that the system seems handy and that it is impressive how such a device has so many functionalities. At the beginning of the test period an informal caregivers explained that reminders, for example for medication, would be of added value for her mother.

5 seniors mentioned that they already have alternative ways of reaching the goal of GUARDIAN and therefore expect GUARDIAN to have no use for them. They for example make use of a paper agenda, have a very strict daily pattern and have no difficulty following it or live with a partner that helps reminding them. Some participants mentioned that it would mainly help people that are live alone or experience loneliness. Also they expect it to be useful for people with (mild) memory loss.

The expected usefulness of GUARDIAN according to formal caregivers differs. They mention that it does not replace the tasks they do because they still have to check whether reminders are followed. Moreover, the system could be more elaborate, by adding an alarm functionality more interaction options for the senior to initiate.

> *"It's amazing that a small device like that can do all those things!" – S*
>
> *"It's a nice invention, but I think it would be more beneficial for someone who is alone. Then the loneliness kicks in. We are with the two of us, so we have each other." – S*
>
> *"My first reaction is sceptical. I will first have to see what the use of it is. Is it for Alzheimer's' patients?" – S*
>
> *"On a daily basis the system is nice, especially for medication reminders." - IC*

5.3.1.1 *Appearance*

In general, the first response to the appearance of GUARDIAN was **positive**. Participants experienced GUARDIAN as a character and ascribed human characteristics to the robot. Many seniors personalised the name of GUARDIAN and started talking to the robot immediately. Seniors used phrases as 'Misty is staying over', which indicates that people form a connection. Some participants especially found the eyes of GUARDIAN very nice. While both being perceived as a human-like character, the first responses to the appearance of Misty and Liz differed. Liz was described as 'a cute girl' and 'friendly', Misty is described as 'more advanced' and 'fun'. For most formal caregivers, the first impression of the dashboard of GUARDIAN is that it is very clear. Most of the caregivers were able to quickly find the information and settings they were looking for. A few participating caregivers needed a bit of practice to get used to the system, but all of them managed to work with it.

> *"She looks very nice!" – S*
>
> *"Misty really stands out. Because she is large, it is very easy to notice" - S*

5.3.1.2 *(Voice) interaction*

Almost all participants (seniors, informal caregivers and formal caregivers) at first expected that GUARDIAN would talk back when they say something. They expected it to have voice interaction, as they compared it to systems they are already (somewhat) familiar with such as Alexa or Siri.

After having the robot in house for a few days, multiple seniors were disappointed with what GUARDIAN could do and also what they could do with GUARDIAN. They expected more freedom in the interaction they could have with the system. The few buttons in the senior application were a bit too limited, because most participants tried out every button in the first two days they had GUARDIAN at home. It resulted in the system being experienced as somewhat boring.

> *"Misty is kind of a thing that just stands there and does not do anything" - S*
>
> *"It really needs to learn how to chit chat a bit more!" - S*
>
> *"She is funny and cute, but only when the nurses or children came to visit. When just being at home with such a thing, it is a bit boring." – S*
>
> *"The interaction is way too little. I expected more reactions to my answers. I would like to have interaction via speech." - S*

5.3.2 User-friendliness

The robot(s)

The seniors were asked about the ease-of-use and satisfaction in a set of items containing eight statements they could indicate to what extent they agreed upon on a 7-point Likert scale. These statements were about the robots in combination with the senior application. Results showed that on average, seniors are satisfied with the user-friendliness of the system. That is, five statements score between 6.6 and 6.8, which is very high. The pleasantness of the interface scores a 5.9 which is a little lower but still deemed as good. Two clear reductions in scores were seen at the overall satisfaction (5.1) and the expected functions and capabilities (3.4). Hence, this indicates that the overall GUARDIAN system (robot + senior application) for seniors is easy to use, seniors felt comfortable while using the system and they liked using it. However, there is a drop visible in overall satisfaction and this is probably due to the unmet expectations of the system in terms of functionalities and capabilities. While comparing the results over the two different robots (Liz and Misty), the same pattern occurs. Both robots score somewhat **similar on user-friendliness**. The drops occur again in the expectations of functionalities and capabilities of the robot. Misty scores a little higher compared to Liz (3.8 vs. 3.1), still for both robots, a drop in comparison to the other statements can be observed (all above 5.7). However, there was a clear difference between both robots while comparing the overall satisfaction. Misty scores higher than Liz (6.2 vs. 4.4). A possible explanation is not researched. Therefore, it is recommended to conduct further research on this comparison between the two robots.

The caregiver application

Formal and informal caregivers were asked about the user-friendliness during the interview. The questions were intended to retrieve the ease of use of the caregiver application, the purpose of using the caregiver application, and the number of times using the caregiver application on a daily basis. Results showed that informal caregivers did not have any issues while using the caregiver application. Hence, the system can be concluded as user friendly for the user group that was involved as informal caregivers. Besides, informal caregivers indicated to have used the system at least once a day, some even twice a day. The purpose of using the system was mainly to set messages and to check whether everything was okay with the corresponding senior.

> *"Yes it was easy to use. I did not need to check the user manual, I could figure out everything myself" - IC*

> *"I checked the application twice a day, in the morning and in the evening" - IC*

> *"I used the application to see whether everything was okay. But I'm doing that already with her e-file from the care organisation" - IC*

Formal caregivers respond differently to the ease of use of the caregiver application. Namely, some indicate that everything is clear and easy to operate, but two indicate to have some remarks. That is, one of the formal caregivers thinks the system has too many components which makes the system hard to install and to learn; another indicates that everything was clear for her, but the caregiver application requires some experience with technological devices in order to know how to operate the system. Three formal caregivers indicate to have used the system on a daily basis to check whether clients responded to the questions. Others report to not have used the system in their daily routine.

> *"I used the caregiver application daily to see whether clients responded. But I also reacted to the notifications I received via mail" - FC*

> *"No, the system is not user-friendly, it contains too many components. You have a tablet, a wifi device, the senior and caregiver applications, and the robot. The home care nurse running the project was not able to install the robot herself. The system is difficult for the clients as well" - Formal caregiver/IT specialist.*

5.3.3 Interaction and personalization

5.3.3.1 *Persuasiveness*

The persuasiveness of the GUARDIAN system was researched by the perceived persuasiveness questionnaire (Lehto et al., 2012) as well as by asking open questions during the interviews. The questionnaire existed of three statements at which the seniors could indicate to what extent they agree on a 7-point Likert scale. It turned out that, on average, seniors did not agree with all three statements. That is, the robot of the GUARDIAN system did not have that much influence on the seniors *(3.3 out of 7, n=15)*; the robot was not personally relevant to the seniors *(2.6 out of 7, n=12)*; and the robot did not make the seniors reconsider their daily patterns *(2.3 out of 7, n=12)*.

Seniors provided several explanations for this lack of perceived persuasiveness. A recurring explanation was that the reminders or suggestions did not always fit the situation and therefore did not influence the senior. For example, one of the seniors indicated to use antibiotics which should be taken exactly one hour before and one hour after dinner. Hence, the reminders needed strict timing which made the influence of the robot smaller when the timing was wrong. Furthermore, the robots

seemed irrelevant to the seniors because most of the seniors did not have the feeling of needing such a robot yet.

> *"It's not relevant yet because I don't need any help yet. It could be more relevant for people who are a bit further in the dementia process" - S*

Finally, the seniors indicated they experienced their response options and autonomy as too limited. Moreover, they miss the possibility to talk to the robot. All three resulted in a smaller influence and less relevance of the robots, as was indicated by the seniors.

> *"The robot is irrelevant because I cannot reply to messages. If [my informal caregiver] sends me a message via the system, I need my phone or tablet to respond to it because I cannot use the system to respond to messages" - S*

> *"Liz is a tablet that just stands in front of me and looks really nice. She does whatever she is programmed to do, but she does not say anything else. [...] I want to decide myself what Liz does and what she doesn't do" - S*

> *"I am someone who wants to react immediately to something, and I may get annoyed if I don't complete the action or question. Therefore, the influence of the robot was not convenient for me"- S*

Contradicting to the low perceived persuasiveness by the seniors, almost all seniors indicated to always follow up on the reminders and suggestions that were provided by the robots. Although some seniors stated that they did not like that the reminders are the same every day, the reminders did not always fit the situation, and they doubt whether caregivers look at the filled-in questions, they still indicated to always follow up on the reminders.

> *"The reminders do not always match the situation but I think it is nice to get a reminder. Especially the medication reminders" - S*

> *"I do not immediately follow up on the reminders but in the end, I always did. But, it was always already in my head to do so, so I did not really need the reminders. Still, they are useful" - Senior.*

> *"I reacted always. Yes, I follow up all of the reminders" - S*

The same statements were also discussed with the formal caregivers and informal caregivers. Results showed that the caregivers mostly thought that the robots **did not really influence the seniors**. However, they noticed that the seniors **really liked the robots** and some of the seniors interacted with them as a real person. Furthermore, they think the robots can be helpful with reminders about medicine intake and daily patterns. Also, one of the formal caregivers noted that the robot was personally relevant to the clients because some clients were disappointed that the robot did not respond to them at some point. Finally, one of the formal caregivers adds that one of their clients felt ashamed to show the robot to visitors because it meant she needed help. To conclude, the formal caregivers and informal caregivers clearly saw the seniors feeling connected to the robot. However, this connection was not enough for the robot to have a persuasive influence on the seniors.

5.3.3.2 *Interaction*

After interacting with the system for two weeks, most seniors indicated that they liked the interaction but that it still can be improved. A clear improvement for all the seniors would be to add speech. *"It's*

a pity that it doesn't respond to voice" was a common statement by the seniors. Another often reported comment was the limit in response options. Again, speech was a favoured addition as a response option for the seniors. Also, one of the seniors would like to answer the messages that are sent by the caregivers by clicking on emoji's. Although this lack of speech, most seniors either indicated to like the companionship or this was clearly observed by the researchers and/or caregivers. Seniors often referred to messages that were told by the robot and e.g. said they liked the message or had to laugh about it. Besides, seniors seemed connected to the robot as was told by the seniors themselves or observed when, for example, seniors renamed the robot and talked to it a lot. Moreover, such a connection was sometimes observed and affirmed by the informal caregivers of the corresponding seniors. One of the seniors said she liked the eye-contact skill of the Misty robot, as well as the sounds it made while being stroked. According to her, it results in a small human-aspect which is really important in the interaction.

> *"I like the personal messages about my painting classes" - S*
>
> *"I could clearly see my parents-in-law were connected to the robots" - Informal caregiver*
>
> *"It's a nice companionship. You know it is just a robot, but still, the companionship is nice" - S*
>
> *"There's no real interaction with the robot. I keep on chatting to her, but she does not respond" - S*

Informal caregivers did not notice any differences in the interaction between them and the seniors. However, they liked to send some messages to the seniors and one of the informal caregivers told she felt relief and easiness by being able to check their parents took their medicines every day and woke up every morning. The formal caregivers indicated that they used the responses to the reports and the robot itself as conversational topics while visiting the seniors.

> *"It resulted in more conversational topics which was a positive experience" - FC*

Figure 7: Project partners testing functionalities at Vilans in the Netherlands

5.3.3.3 *Personalization*

Seniors indicated that they liked the personalized messages, containing reminders of e.g. their favourite television programmes, sports matches, local news and personal agendas. These messages

were often referred to by the seniors during the interviews, often combined with a positive note. The reminders for medication could have been more personalized according to some of the seniors because they did not always fit the situation. Other aspects that could be personalized for the seniors are more about the design and size of the robots.

> *"I do like the little man [Misty] more than the flat lady [Liz], because only such an image does not feel real to me" - S*
>
> *"Nice that the robot started about my personal life" - S*
> *"It was good that Liz reminded me about the Ajax match, otherwise I would have forgotten about it" - S*
>
> *"The system would be more intended for fun to me, not so much as what it really is intended for" - S*
>
> *"The size of the robot is not so handy to me" - S*

5.3.3.4 *Social connectedness*

When asked about the social connection with caregivers via the GUARDIAN system, seniors were reluctant to rate this connection as being improved. However, they could imagine that improved versions of the system can help in establishing a better connection. The main focus should be on developing more answer options for the seniors to respond to the messages that are sent by caregivers. Furthermore, seniors were doubting whether formal caregivers really looked into the system, and hence, they especially liked that their informal caregivers could use the application.

> *"I don't feel that the connection is improved, because if [my informal caregiver] sends me a message, I cannot answer him and I don't have real contact" - S*
>
> *"It could help if the system works well, Misty needs to talk for that" - S*
>
> *"Healthcare personnel does not need to be connected via the platform, I have my alarmbutton for that. I do especially like the application for my informal caregiver" - S*

The caregivers have varying opinions about social connectedness via the system. One informal caregiver indicated to prefer to call. Others indicate they like the system and think social connectedness could benefit from it, but the system should be improved first. Another thinks that the system is better in privacy because formal caregivers tend to use Whatsapp to discuss clients, the GUARDIAN system is probably better designed in terms of privacy regulations. Finally, a formal caregiver indicates that more interaction through speech would be a good way to improve the social connectedness.

> *"I prefer to call, then I can hear her voice and can already tell if things are going well or not" - IC*
>
> *"Formal caregivers no loger have to use Whatsapp, the GUARDIAN system is probably better in terms of privacy" - IC*
>
> *"Yes, it helps in social connectedness. But, the system should be improved" - FC*
>
> *"More interaction through speech would be a good way to improve the system" - FC*

5.3.4 Responsible Innovation

What do you think of your privacy while using the system? Do you feel to have control over the GUARDIAN system Do you trust the GUARDIAN system? How do you feel about your privacy when you are at the senior's home and the robot is there? Do you have any concerns or do you see risks when using a system such as GUARDIAN to take into account in further development?

5.3.4.1 *Privacy*

In the Netherlands the majority of the seniors (7/13) had no concerns about their privacy while using the GUARDIAN system in their home; they 'did not think of this at all', 'have nothing to hide', 'it is important to trust the informal and formal caregiver'. Several participants mentioned that in these days privacy is already limited and it is not possible to use a system such as GUARDIAN without compromising a part of your privacy. Most of the seniors don't seem to mind this.

Informal and formal caregivers were more critical about the privacy aspect. When a concern was mentioned, it was mainly about the use of the camera. This should be as limited as possible and it should be clear for which functionalities it is used. There was also a remark by one the informal caregiver that it is important that it is possible that a formal caregiver sees different information in the app then a informal caregiver. For example it was suggested that appointments should not be visible for the formal caregivers. In this prototype it is already possible to account for this in the settings, but it makes it even more clear that is important that the senior is involved in setting up the system.

> *"There is no such thing as privacy anymore […]. My name is on the mailbox with my house number. What then is privacy? Also, I cycle 10 km every day and my wife can exactly see in which street I'm riding through an app." – S*
>
> *"My children can know everything […]. My caregiver does not need to know what appointments I have" – S*
>
> *"I have no problem with it in my own situation. I do have a smart speaker. If you want to interact, you have to be flexible with this" - IT-support*
>
> *"You must be able to cover the camera with for example a thing like you put on your webcam" – FC*
>
> *"Depends who has access to the data, especially the videos. If it remains within our organization it is okay. We had informal caregivers who installed webcams in the home of their loved one to monitor what is going on. This means they can also see what I'm doing"* - FC

Similar results were found for the formal and informal caregivers.

5.3.4.2 *Feeling of control and trust*

Eight of the thirteen seniors **felt in control** of the robots (Liz and Misty) for example because they were able to mute the prototype themselves, they found it easy to use and the robot did what was programmed into it. Some of the participants did not feel in control and expressed that this was mainly because of technical issues that occurred during testing of the Misty robot. Similar results are seen for trusting the robot.

Risks and concerns while using the GUARDIAN system

Overall formal and informal caregivers found it difficult to think of concerns and risks which might be important to take into account for further development of a system such as GUARDIAN. The few concerns that were mentioned are:
1) Elderly can become to dependent on the robot
2) Privacy issues (use of camara, access data)
3) Time (informal) caregivers should invest to check the system
4) Responsibility of what is put in the system lies with (informal) caregivers. Important to make sure it matches the needs and desires of the senior.
5) Limited social control and therefore risk of isolation

5.3.4.3 *Willingness to pay*

Participants (seniors, formal and informal caregivers) found it difficult to answer this question. Mainly because the system is still a prototype and was not always functioning properly. Also due to the rising inflation they find it difficult to estimate a reasonable price. Therefore 14 participant did not answer this question. When asking what they would like to pay for a fully developed system four seniors did not want to pay at all and three seniors answered that they are willing to pay a similar contribution as what they pay for the personal alarm system they use, which is around 25 euro's per month. One senior and informal caregiver said to be willing to pay a higher amount of around 50-100 euro per month. It was however noticed that these participants mention this because they think the robot is quite expansive. An important reason for not willing to pay mentioned by seniors as well as an informal caregiver was that the care should pay or the insurance company because it is to relieve their care burden. Preferably they don't want to pay at all or just a small personal contribution.

> *"It is part of the care. If the care is more efficient because of such a robot, the care organization will need to pay for it. And if not the care organization, then the insurer should" – S*

> *"It is an extension to the nurses. We already pay a lot to the care organization and insurance. Therefore as little as possible, preferably nothing" – IC*

Table 3. Willingness to pay by month by the participant

Willingness to pay	Senior	Informal caregiver	Formal caregiver
€0,-	4	2	3
€5,-	x	x	x
€10,-	x	x	x
€15,-	1	x	x
€25,-	2	x	2
Else	1 (€50-100)	1 (€50)	x
Not able to answer	5	3	6

5.3.5 Positive aspects & points for improvement

Table 4. Point of improvement and positive aspects for the system

	Points for improvement	Positive aspects
Misty	Too much noise of the ventilators	
	Prompt sound is perceived as scary	
	Tablet and robot should be combined in one device	
Liz	Font size to small	Small and easy solution
	Voice should be more human-like	User friendly
	Device is not heavy enough (push it over easily)	Friendly voice
GUARDIAN system in total	Limited autonomy senior; cannot add things themselves	The personal messages
	Functionalities missing; physical assistance, alarm button, fall detection	The extra attention for the senior (even if it is mechanical)
	Limited interaction; senior not able to response by voice/or type in the answer, robot needs to say more	Medication reminders
	System is not stable; Errors can jeopardize safety. Check is still needed	Perceived as buddy/clients react positively to the 'buddy'
	Limited mobility of the robot; it stands in one room	Sleep mode
	Better and cheaper alternatives available (Google home, senior tablet, whatsapp etc.)	Added value for people who are lonely
	Can make relationship with loved one more distant -	Bringing something fun to the senior; the little perks such as tickling, touching and different responses
		Good for daytime structure; through the agenda
		Eyes of Misty
		The little perks/fun factor
Caregiver app	Message functionality in Caregiver app limited; number of characters limited, no repeat functionality, confirmation that message is read not available	Caregiver app is very clear

"I liked the personal messages, suddenly it started to talk about my painting classes. This makes the interaction more personal"- S

"Correct size, you can put it down somewhere easily where you can hear and see the robot good" – S about Liz

"I also believe that the care organization should play a role in this. If there are errors, it would also jeopardizes safety. Especially with medication" – IC

"It could really have added value. Bringing life and something fun to the person you care for. It could really be an addition to sending a whatsapp" - IC

"It can be very functional for early stage dementia, so they can benefit more later when the dementia progresses." – IC

"It looks fun, the eyes are very nice. When you see you'll fall in love immediately" - FC

5.3.6 Results Misty – Liz comparison:

5.3.6.1 *General functionalities and concept*

Participants experienced Misty and Liz as similar concepts. **Whereas the preference for Misty vs. Liz appeared to be a personal preference**, in general participants were positive regarding the concept as a whole.

Participants recognized that the functionalities and application are the same for Misty and Liz and also experienced it as a similar system. Participants didn't experience differences in the reminders, requests, personalized social messages, jokes and facts.

In terms of future improvements, almost all participants indicated they would like to be able to speak to or have a conversation with the robots – both Misty and Liz.

"The expected effect will be the same for both robots" – IC

"I didn't really notice any difference in the effect on my friend between the two robots." – IC

"No, there is not really a difference. Except for the appearance and the lay-out, they were very much alike." - FC

Functioning and bugs

During the beta testing, 2 senior participants encountered major issues with Misty, therefore it was difficult for these seniors to make a comparison between the two robots. For both robots some minor issues occurred during the test, but that did not significantly influence the experience of the robots.

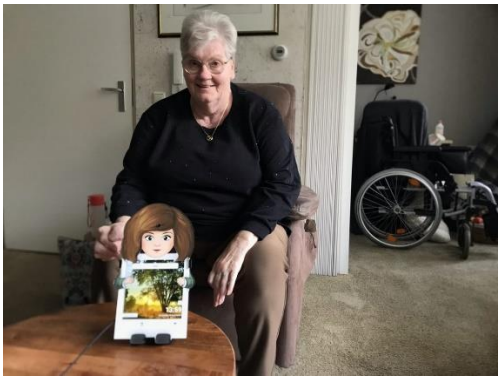


Figure 8: Participants of the beta testing phase in The Netherlands

5.3.6.2 *Appearance and experienced bonding*

Appearance: The experiences regarding the appearance of Misty and Liz differ per participant and seem to be a personal preference. Liz is found to be cute and nice to look at by some participants, whereas other participants liked the robot look-and-feel of Misty more.

Social bonding: None of the participants mentioned any real experienced social bonding, however we observed that all participants spoke to both robots in a caring way. For Liz, words as 'my girlfriend' and the nickname 'Lizzy' were used. More participants were inclined to personalize the name of Misty. Misty is called *Floor* at ZNWV, but Misty was also *Frits* and *Flip* by participants. The voice for Misty could be changed from female to male, which was preferred by some participants. Two other seniors mentioned that they liked Liz's voice better. For Liz, the option to personalize the character is expected and desired. The freedom of the design of Liz, triggers curiosity for different types of characters.

> *"Liz is a cute girl, she is nicer to look at" – S*
>
> *"She is somewhat funny and cute, but only when the nurses or children came to visit. When just being at home with such a thing, it is a bit boring." – S*
>
> *"Liz was my girlfriend in the house, it's like a toy to me." – S*
>
> *"Having Misty is like having a connection with someone. I liked that she was blinking every now and then, she's active." - S*
>
> *"That other robot (Misty) is more really a robot" – S*
>
> *"Liz is just a tablet and is less capable of interaction. Misty feels more like a human being in the house and therefore perceived as more 'present'." – S*
>
> *"Liz could be personalized to a cat or cartoon-figure. I know someone who would like Tintin as a character." - S*
>
> *"I thought Liz was quite funny, so small. But I don't really see the added value of the head. It is inviting to start using." - FC*

5.3.6.3 *Fit in the home*

The difference in size of the robots has advantages and disadvantages for the participants. Liz is smaller than Misty, and is therefore found to be a better fit in the often small homes of seniors. And a formal caregiver mentioned how it being less noticeable would help decrease the embarrassment of needing such help. However, the small design of Liz also led to one participant easily pushing over Liz due to limited motor skills. Participants found Misty to be more bulky and blunt and needed a lot of space for it. Another formal caregiver mentioned that the size of Misty is an advantage because it is easier to notice for the senior.

A big disadvantage that most seniors experienced was **the noise** of Misty. During the beta pilot test, Misty was on the charger non-stop and thus making a lot of noise and distracting the participants. One participant had to stop the beta test with Misty because the noise of Misty was too invasive for her.

> *"Liz could stand between the plants. You need a lot of space for Misty. He's a bit of a blunt guy." - S*
>
> *"I had to be careful not to push Liz over. As I have some difficulty with motor skills (mobility), I easily pushed too hard and pushed her over." – S*
>
> *"She was having trouble with the noise of Misty. it would have been better to have an online avatar." – IC*
>
> *"Misty is larger, easier to notice because it shows better. But it makes more noise." - FC*
>
> *"Liz seems better because it's less notable, so probably less embarrassment is experienced." - FC*

5.3.6.4 *Behaviour and usability*

Two participants mentioned that Liz is easy to use and easy to manage. Other participants found Liz more difficult to use due to the dark background and the small buttons and text. In observation, all participants were able to use Liz but some mentioned that Liz could be more difficult for other people, such as people with dementia. Also formal caregivers mentioned that Liz was a bit too small. On the other hand, a formal caregiver found Liz easier to use, because of less complex installation and less parts. The technical staff mentioned that there are too many components of Misty for it to be easy to use in daily life.

For Misty, the buttons on the tablet were easier to use and the text was better readable. However, the options for self-initiated interaction were experienced as limited. One participant mentioned that the messages of Misty were sometimes hard to hear.

Regarding the physical interaction with Misty, one participant especially liked that when they touched the head, Misty makes a sound. A limitation of Misty is that the on/off button is not accessible and therefore limiting the autonomy of the senior.

> *"I find it positive that you are able to use the Liz easily" – S*
>
> *"Liz felt a little more manageable. That I had a bit more control." - S*

"Misty has to be functional. It does have to do something, and not just stay there as a dead thing. I can only do 2 things myself." – S

"Misty is more of a thing that just stands there and doesn't do anything." - S

"Liz was really small. The font should be bigger, but maybe the tablet is too small. Maybe it could be a bit bigger in general." – FC

"The little perks are funny, on 'tickling', it responses. The contact (touching etc) are very good." – FC

"Liz was easier to install. So, for ease of use, I would prefer Liz." - FC

5.3.6.5 *Willingness to pay*

In general, people have difficulty indicating how much they are willing to pay for a robot and think the health insurer or care organization should pay most of the costs. When asking specifically about the differences between Misty and Liz, two participants mentioned that they want to pay more for Misty. One participant mentioned that they like Liz more, and therefore are more willing to pay for Liz than for Misty.

"50 euro per month for Liz and 100 euro per month for Misty." – S

"I like Liz more. I would be more willing to pay for Liz than for Misty." – S

With the comparative research of two similar GUARDIAN systems that make use of a different type of robot (Misty and Liz), we studied the added value of the physical manifestation of Misty in the form of moving arms and head and the larger size. The comparative study shows that the physical form of Misty do not seem to have significant impact on the experience, usability or acceptance of a social robot. An added value could lie in the ability to drive around, but that functionality has not been researched in this project. Another possible advantage of the Misty robot, could be the notability of the robot due to the size.

As end-users did have a personal preference regarding the appearance of the robot (the robot look&feel and the girl look&feel). Therefore personalizing the character of the social robot would be advised. In general, end-users do see value in a social companion as GUARDIAN, which provides opportunity to further develop hybrid solutions such as Liz in the future.

6 Conclusion

To conclude, we could highlight the preferences of the users. It seems that in all countries, Misty's design has been obtained as cute and can serve to keep company. The personal messages from the caregiver have been appreciated and the caregiver application was for most people easy to use. However, as with any development project, multiple users reported that the system still needs to be improved. We received many wishes for the tablet to be removed or to have Misty and the tablet combined, as well as to have a robot that can recognise the voices for a better interaction. The system is not always stable too, mainly because everything has to be connected to the Wi-Fi and turned on at all times, it therefore led to disconnections. For the caregivers, although they mostly liked the app, they wished for more features, and more personalised ones. The GUARDIAN system is promising and globally participants see potential in it, however the system needs to be improved for the participants to imagine using it in real life situations, and to trust it as well. We found some differences and similarities between the three different countries and cultures.

In Switzerland, participants appreciated the different features, and showed lots of great ideas to keep improving the system, like more voice interaction. Although some seniors expressed few user-friendly difficulties with the use of the tablet, caregivers fully used and appreciated their own website. In respect to expected usefulness there were difficulties for seniors to use the system, and as the hardest part to understand was the tablet, for IC and FCs their apps were easy to use.

In Italy, users wanted to have more interaction possibilities, and expect for future development an easy way to do it, to reach their goals. They specifically mentioned a vocal command that would be more intuitive for them and therefore, they would use it for lots of different reasons. As the system is for now, seniors see it more as a tool for company, when formal caregivers particularly see its potential in support for health monitoring. Their private life does not feel threatened by the use of the system, as they consider it a part of new technologies that is not scarier than having a smartphone.

In the Netherlands, end-users had high expectations of the interaction with the system, because they are already familiar with alternative technologies such as SIRI, Google Home and WhatsApp. Seniors did feel connected to GUARDIAN, but not enough to have a persuasive influence although they did follow up the reminders. The main reason for a lack of persuasive influence is that they found the interaction with the robot limited. An important improvement therefore is to elaborate the possibilities of interaction between the robot and the senior. They wanted to be able to interact by voice (similar to the Italian participants), have a more diverse dialogue and be able to have more options in the senior app to interact with the system. A functionality which was missed by the majority of the end-users was an alarm functionality or the possibility to connect the system to the alarm button the senior is already using. This might therefore be an interesting functionality to research for future development of the GUARDIAN system. The specific attention to RI resulted in the identification of several risks which are important to account for in future development and research of systems such as GUARDIAN. Concerns were mainly raised about the use of the camera, this usage should be limited, and the functional goals should be clear. Furthermore, in The Netherlands, no clear differences between Liz and Misty were found. Both were being perceived as a human-like character. The physical form of Misty does not seem to have significant impact on the experience, usability or acceptance of a social robot. Nevertheless, Misty did score higher in **overall satisfaction**. Hence, it can be interesting to conduct more research in the comparison between different types of robots as social companions. An added value of Misty could lie in the ability to drive around, which might be valuable to research in a future project as well. Each participant had its personal preference for one of the two robots. Liz was mainly described as ‘a cute girl’ and ‘friendly’, Misty as ‘more advanced’ and ‘fun’. Therefore personalizing the character of the social robot would be advised.

To conclude, participants in all three countries liked the GUARDIAN system and see the potential for GUARDIAN to be of added value to seniors and their formal and informal caregivers. They reported that it is most beneficial for seniors living alone and having (mild) memory loss. The senior- and caregiver application of the GUARDIAN system were both described as clear. Some participants needed a bit of practice to get used to the system, but all managed to work with it. Seniors expressed their willingness to be able to communicate more with their caregivers via the system, and caregivers to have more feedback from the seniors. All in all, room for improvement still exists but end-users clearly expressed to evaluate the potential of systems like GUARDIAN as positive and expect these systems as a valuable addition to the domain of healthcare.

7 Appendix

Appendix A : Comparison Misty and Liz

Key functionalities of GUARDIAN/Misty vs Liz :

The tables below show an overview of the key functionalities of GUARDIAN system, in comparison to the functionalities of Liz.

Reminders and reports :

Functionality	**Misty**	**Liz**
Medication reminder and request	Yes	Yes
Meal reminder and request	Yes	Yes
Well-being request	Yes	Yes
Sleep quality request	Yes	Yes
Follow-up question for well-being and sleep quality	Yes	Yes
Self-report possibility for well-being and sleep quality	Yes	Yes

For the Liz robot, all reminders and reports can be configured in a similar way compared to GUARDIAN/Misty. In particular, both the timing and phrasing of the reminder messages can be configured in line with Misty's reminder messages. Next to that, follow-up questions are implemented for sleep quality and well-being and make use of the same answer options as in Misty. In Liz, seniors can also self-report their well-being and sleep quality by pressing the '+' on the home screen.

General settings :

Functionality	**Misty**	**Liz**
Turning the volume on/off	Yes	Yes
Changing the volume level	Yes	Yes
Changing the pace of the voice	Yes	No
Changing the voice male/female	Yes	No
Sleep functionality	Yes	Yes

In Misty, the volume of the voice can be increased or decreased by the user. In Liz, the volume can easily be turned on and off. Moreover, at the beginning of a test period, the exact volume of Liz can be set as preferred through the tablet settings. In Liz the pace of the voice and a male/female voice cannot be set manually by the user.

To allow the user to pause the system, the sleep functionality of GUARDIAN is also implemented in Liz. The end-user can manually turn on the sleep-mode, which leads to the screen to be darkened, the eyes of Liz to be closed and all the reminders to be muted. The participant can also wake up Liz manually.

Social robot :

Functionality	**Misty**	**Liz**

Empathetic responses in TTS	Yes	Yes
Empathetic responses in eyes and movements	Yes	Yes
Answering yes/no in STT	Partly	No
Eye contact	Yes	No
Sound interaction when touching head	Yes	Yes

To empathize the socialness of the both the robots, three functionalities have been implemented in prototype 3 of the GUARDIAN system, and thus also in the Liz prototype:

(1) For each response that the senior gives, both Misty and Liz answer with different messages to the senior. For example, when someone says they are not feeling well because of a headache, Liz and Misty respond differently than when the person reports that they have taken their medication. The same set of response messages from Misty has also been programmed into Liz.
(2) For each response of a senior, in Misty different head and arm movements are used. For Liz we implemented this functionality as different facial expressions and different hand gestures for the different responses.
(3) When touching Misty's head, Misty makes a sound. In Liz, this functionality is implemented as follows: when tickling the nose of Liz (press-and-holding for 1s), Liz giggles, including sound and a change in facial expression and hand gestures.

In Liz, the eye contact skill and the possibility to answer with yes and no by speech are not implemented.

Other functionalities :

Functionality	**Misty**	**Liz**
Messages	Yes	Yes
Calendar and appointments	Yes	Yes

In Misty and Liz the messaging functionality is implemented similarly. The messaging functionality is used by caregivers to share various types of messages (e.g., "You're doing fine!"). Secondly, messages can be pre-programmed, and used to increase the social qualities of the robot. During beta testing, researchers added social messages on for example suggestions for activities or tv programs, jokes and small pieces of news and personal messages throughout the day. In both Misty and Liz, the messages that have been used to make the robot experienced as more social were the same.

The calendar and appointments functionality in Misty and Liz was similar. In Liz the senior was also able to see the appointments in the future and in the past, instead of only the appointments of today.

Appendix B : Switzerland's flyer to recruit participants

PARTICIPEZ AU DÉVELOPPEMENT D'UN ROBOT SOCIAL

Le Service des sciences de l'information médicale des HUG (**SIMED**) vous invite à participer au développement d'un robot social qui accompagne le personnel soignant et les proches aidants dans la relation d'aide aux aînés (projet de recherche européen **GUARDIAN**).

Le robot social, appelé **Misty**, offre les prestations suivantes :

- Informer les aide-soignants et proches aidant·es sur le bien-être des seniors vivant à domicile
- Apporter de la compagnie et organiser votre quotidien grâce à des options de conversation, de rappels, de planification de buts personnels, etc.

Qui peut participer ?

Prenez contact avec nous, si les thématiques de santé vous intéressent et que vous êtes :

- Un ou une senior de plus de 65 ans
- Un ou une proche aidante (famille ou amis qui aident une personne âgée)
- Un ou une professionnelle de la santé active dans les soins à domicile (infirmiers, aides à domicile, etc.).

Si vous souhaitez particper à cette étude, merci de contacter l'équipe du projet GUARDIAN à l'adresse ci-dessous.
Un défraiement de 100 chf par participant.e est proposé.

Julie GUEBEY
Assistante de recherche
Service des Sciences De L'Information Médicale
julie.guebey@hcuge.ch
+33 6 28 68 00 02

Guardian | HUG Hôpitaux Universitaires Genève

Appendix C: Flyer with information about the research

Appendix D: Personalization during beta testing

Collect information in advance to personalize sentences via messaging function.

- Ask the client/informal carer beforehand, and use google (weather/news etc.)
- Partly search yourself (weather & current affairs)

Activities & Appointments	What	Moment
What are things you like to do? And when do you usually do that?	1. 2. 3.	
Who or what is important to you?		
What do you like to watch on TV? (also ask if they watch certain church services)		
Do you like to read? If so, what? (newspaper, certain book, magazine)		
Are there any birthdays or other appointments in the next		

two weeks that we can put in GUARDIAN?		
What music and/or radio station do you like to listen to?		
Lifestyle		
What time do you usually get up?		
What time do you usually go to sleep?		
What time do you usually have breakfast/lunch/dinner?		
What do you like to eat and drink?		
Interaction		
How would you like to be addressed by Floor? With your first name or last name?		
What would you like the robot to say to you?		
What do you like to deal with? Direct/less direct?		
Weather		
Find out what the weather forecast is for the next two weeks so you can use it when you think about the weather		
Current affairs		
Find some news from that week that your robot can say something about		

Example sentences

Category	**Sense**
Compliments	You smell so good! How beautiful you look today! What did you eat well today (with people who eat around food set many reminders) I'm proud of you What a good job you are doing! What are you active today, keep up the good work I think you look good today I really enjoy visiting you
Activities	*Beforehand* It's almost time for [activity/program] Don't forget your favorite [activity/program] Church begins at [time] I'm already ready for [activity], will you join? When I do [activity], I immediately feel a lot better. Do you? *After activity*

	I hope you enjoyed [activity/program] It's time to go, [activity] starts like this Hopefully you like [activity]
Lifestyle	Good morning [name] How early you are today! I slept wonderfully, I hope you did too. Good afternoon Enjoy your meal I'm very tired, I'm going to sleep. Good night Good night It's time to go to sleep Close the curtains It's time to go to bed, just brush your teeth I had a nice day, I hope you do too! It was a nice day
Weather	The weather is going to be nice today The sun is shining Tomorrow it will rain, so think of your umbrella
Proverb of the day / Bible diary / saying	Good morning [name] start the day right with a nice saying! [spell] 1. You can only waste time, if you forget to enjoy it 2. I'm getting better by the day, I'm already looking forward to tomorrow 3. You don't get older, you increase in value 4. If everyone counts, you can count on each other 5. Don't wait for a good day, but try to make one yourself 6. Of all that you watch over, watch over your heart, it is the source of your life 7. Count what you have, not what you miss 8. Knowing what you know and knowing what you don't know, that's wisdom! 9. As the clock ticks at home, it doesn't tick anywhere 10. Life is so boring when you're not laughing and not joking. Live life to the fullest and do what makes you happy 11. Never start the day with yesterday's shards 12. It's how it was, it's about how it comes. 13. A river cuts through a rock, not because of its strength, but because of its perseverance 14. There is always someone, but there is no one like you.
Fact of the day 'Did you know ...	Hello [name], it's time for the fact of the day again: Did you know that [fact]. Nice huh, learned something again! Facts: 1. a male ballerina called a ballerino

	2. the sunrise on mars is blue 3. mosquitoes cause the most deaths of all animals 4. the Bible is the most stolen book 5. the elephant is the only animal that can't jump 6. Buckingham Palace has 602 rooms 7. The Nile is the longest river in the world 8. That our foot consists of 52 bones 9. Coca cola was originally green 10. The lighter was invented earlier than matches 11. The Hawaiian alphabet has 12 letters 12. Butterflies taste with their paws 13. Donald Duck comics were banned in Finland because he doesn't wear pants 14. The tongue is the strongest muscle in the human body
Personal	Nice that you visited [person], I hope it was fun

Morning
Good morning wishes
Something about breakfast
Spell of the day
Noon
Good afternoon wishes
Compliment
Something about lunch
Fact of the day
Evening
Something about dinner
Note on how the day was
Good night wishes

Appendix E: Information booklets caregiver application (Liz and Misty) senior application and robot

Handleiding Zorgverlener app

Contactgegevens

- **Technische problemen?**

Technische problemen? Neem contact op met:
Christian Garate Arnaiz,
ICT van ZNWV: 0682182591

- **Vragen over het onderzoek?**

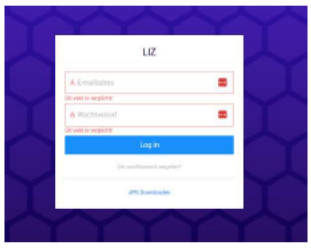
Trude Lugard– Jozuazoon,
coördinator team Stadsweide ZNWV: 0682826544 of 0880563000

Handleiding Zorgverlener app

Voor de zorgverlener app van Liz is ook een video opgenomen. Deze video kunt u bekijken ter verheldering van onderstaande informatie. Vraag Trude waar u deze kunt terugvinden.

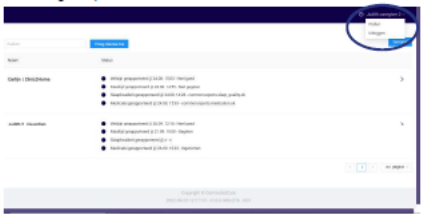
1. Inloggen en nieuw wachtwoord

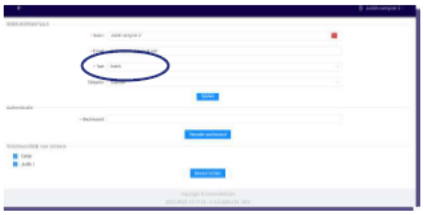
1. U krijgt een inlogcode en een wachtwoord van Trude, waarmee u kunt inloggen op liz.ccare.onlyoneif.com.



5. Taal instellen

U kunt de taal van de applicatie instellen. Klik rechts op uw naam en dan op 'profiel'. In de balk 'taal' (of 'language') kunt u de gewenste taal kiezen. Het is belangrijk om de instellingen op te slaan!





4. Berichten

U kunt berichtjes sturen naar uw client. Liz zal het bericht op het geplande tijdstip voorlezen. Voeg een bericht toe dat je met de senior wilt delen, denk aan een grapje, een compliment, een verjaardag die eraan komt of iets anders dat je met de senior wilt delen.

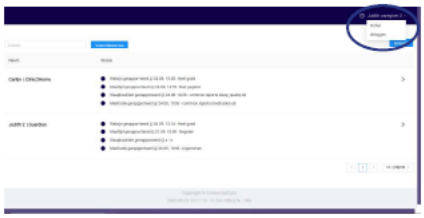
Werkt de zorgverlener app niet? Probeer dan het volgende

1. Sluit de applicatie af (door bijvoorbeeld de homeknop van het apparaat in te drukken en de app weg te vegen of door uw browser te sluiten). Start de app vervolgens opnieuw op.

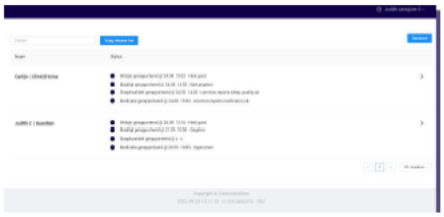
2. Werkt dit niet, dan raden we u aan om uit te loggen bij de app en vervolgens weer opnieuw in te loggen.

3. Werkt dit ook niet neem contact op met ICT

2. Wachtwoord veranderen:
U moet direct uw wachtwoord veranderen. Dat kan door naar 'profiel' te gaan, daar een nieuw wachtwoord te kiezen en op 'wachtwoord veranderen' te klikken.



4. In het **cliëntenoverzicht**, ziet u in één oogopslag uw cliënten en hun laatste rapportages.

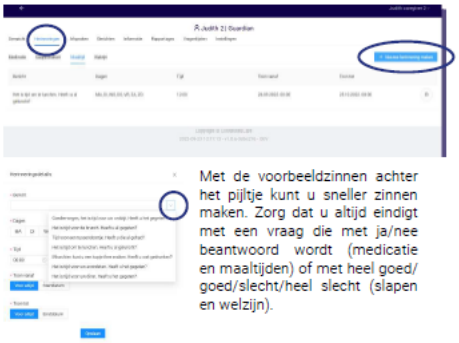


2. Dashboard
Na het selecteren van een cliënt opent het dashboard, waarin u verschillende taken kunt uitvoeren of gegevens bekijken. De bovenste menubalk brengt u naar de verschillende onderdelen van de app. De grafiek in het midden geeft de rapportages van afgelopen week weer en onderaan staan de laatste rapportages van vandaag en berichten.

3. Herinneringen & verzoeken

Voor de modules **maaltijden & medicatie** kunt u een **herinnering** instellen. U kunt instellen dat de robot op een bepaalde tijd een herinnering verstuurd. Klik bijvoorbeeld op 'maaltijd'. Dan ziet u vervolgens welke herinneringen er al zijn ingesteld. Een nieuwe herinnering aanmaken kan via de knop rechtsboven. Liz zal altijd vragen of de maaltijd is gegeten en of de medicatie is ingenomen.

Voor de modules **welzijn en slaapkwaliteit** kunt u op een vergelijkbare manier als de herinneringen een **verzoek** instellen. Op deze manier kunt u via de robot aan de senior vragen hoe hij/zij geslapen heeft of hoe hij/zij zich voelt.



Met de voorbeeldzinnen achter het pijltje kunt u sneller zinnen maken. Zorg dat u altijd eindigt met een vraag die met ja/nee beantwoord wordt (medicatie en maaltijden) of met heel goed/ goed/slecht/heel slecht (slapen en welzijn).

Handleiding Zorgverlener app

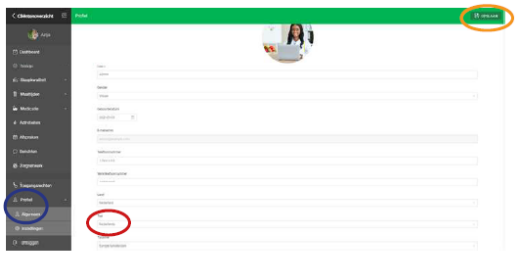
Voor elk van stappentappen zijn ook instructievideo's opgenomen. Deze video's kunt u raadplegen ter verheldering van onderstaande informatie. Vraag Trude waar u deze kunt terugvinden.

1. Inloggen en cliëntoverzicht

1. U krijgt een mail met de vraag of u zich wilt registreren voor Guardian. U kunt op de link in de e-mail klikken om een wachtwoord aan te maken.

5. Taal instellen

U kunt de taal van de applicatie instellen. Klik op 'profiel' in het menu (blauw omcirkeld). In de met rood omcirkelde balk 'taal' (of 'language') kunt u de gewenste taal kiezen. Het is belangrijk om de instellingen op te slaan! Dit doet u door op de met oranje omcirkelde knop 'opslaan' te klikken.



Werkt de zorgverlener app niet? Probeer dan het volgende

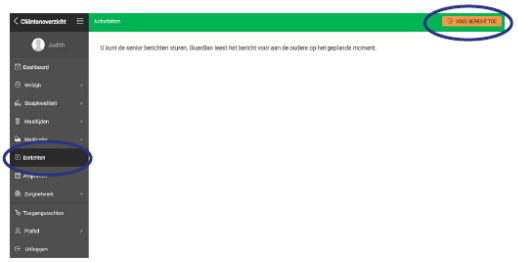
1. Sluit de applicatie af (door bijvoorbeeld de homeknop van het apparaat in te drukken en de app weg te vegen of door uw browser te sluiten). Start de app vervolgens opnieuw op.

2. Werkt dit niet, dan raden we u aan om uit te loggen bij de app en vervolgens weer opnieuw in te loggen.

3. Werkt dit ook niet neem contact op met ICT

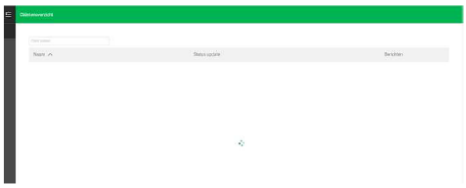
4. Berichten

U kunt berichtjes sturen naar uw client of naaste. GUARDIAN zal het bericht op het geplande tijdstip voorlezen. Voeg een bericht toe dat je met de senior wilt delen, denk aan een grapje, een compliment, nieuws over jou of je familie, een verjaardag die eraan komt of iets anders dat je met de senior wilt delen.



2. U kunt daarna inloggen via de link in de registratie mail of via **www.caregiver.guardian-aal.eu** Vul uw e-mail en wachtwoord in en klik vervolgens op 'log in' om naar het cliëntoverzicht te gaan.

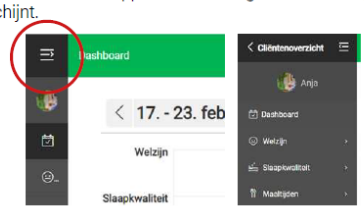
3. U krijgt dan het volgende scherm te zien met in het midden een icoontje om aan te geven dat het scherm aan het laden is. Het laden kan soms wat langer duren (enkele minuten).



4. Vervolgens verschijnt het **cliëntenoverzicht**, waarin u in één opslag ziet wat de status is bij verschillende cliënten (als zorgverlener) of van uw naaste (als mantelzorger).
Meldingen kunnen worden aangeduid met :
= naaste heeft iets niet gerapporteerd,
= naaste heeft een een verzoek, bijvoorbeeld het nemen van medicatie gerapporteerd.
= iets is niet helemaal goed met uw naaste en vergt uw aandacht, bijvoorbeeld: slecht geslapen

2. Dashboard

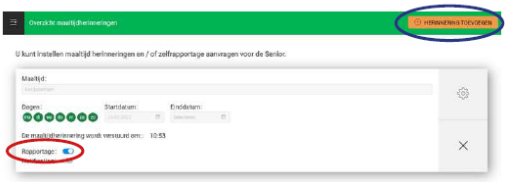
Na het selecteren van een cliënt opent het dashboard, waarin u verschillende taken kunt uitvoeren of gegevens bekijken. Het kan zijn dat de menubalk niet is uitgeklapt. Door op het hamburger menu te klikken (rood omcirkeld) kunt u het menu uitklappen zodat de uitgebreidere weergave verschijnt.



3. Herinneringen & verzoeken

Voor de modules **maaltijden & medicatie** kunt u een **herinnering** instellen. U kunt instellen dat de robot op een bepaalde tijd een herinnering verstuurd. Klik bijvoorbeeld op 'maaltijden'. Dan ziet u vervolgens welke herinneringen er al zijn ingesteld. Een nieuwe herinnering aanmaken kan via de knop rechtsboven (blauw omcirkeld) U kunt tijdens het instellen van een herinnering ook aangeven of u wil dat de oudere gevraagd wordt om aan te geven of hij/ zij ook daadwerkelijk de actie heeft uitgevoerd, dit wordt zelfrapportage genoemd (rood omcirkeld).

Voor de modules **welzijn en slaapkwaliteit** kunt u op een vergelijkbare manier als de herinneringen een **verzoek** instellen. Op deze manier kunt u via de robot aan de senior vragen hoe hij/zij geslapen heeft of hoe hij/zij zich voelt.



Guardian

Opstarten en opladen Floor

Aan & Uitzetten

U kunt Floor aan & uitzetten met de schuifknop aan de onderkant. Schuif het knopje naar links of rechts.

Opladen

Laat Floor aan de oplader. Helaas kan Floor op dit moment nog niet lang genoeg zonder stroom.

Opstarten

Als Floor opstart ziet u eerst dat haar ogen dicht zijn. Wanneer de ogen helemaal open zijn is Floor opgestart. Dit zou niet langer dan een minuut moeten duren. Als u Floor opnieuw wilt opstarten zet Floor dan uit en wacht 10 seconden voor u hem weer aanzet.

Opladen werkt als volgt:

1. Doe de stekker van het oplaadstation in het stopcontact.
2. Controleer of Floor aan staat. De ogen moeten te zien zijn en een paars lampje brandt.
3. Zet Floor op de oplader, de robot moet helemaal tegen de achterkant aan staan, zoals op de foto hieronder.
4. Controleer of er na vijf seconden een oranje lampje langzaam knippert. (zie foto) a. Is er geen oranje lampje te zien? Plaats Floor dan opnieuw op de oplader, helemaal tegen de achterkant.
5. Floor is klaar met opladen als het oranje lampje nog wel brandt maar niet meer (langzaam) knippert.

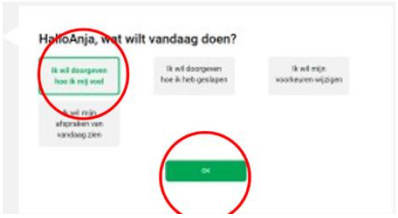
Doorgeven hoe u zich voelt

U wilt uw mantelzorger en zorgverlener graag laten weten hoe u zich vandaag voelt. Bijvoorbeeld dat het niet zo goed gaat omdat u erg last heeft van hoofdpijn. U kunt daarvoor de tablet gebruiken om dit zelf door te geven. Kijk eens rond welke opties u allemaal ziet en of het lukt om dit door te geven.

Stappenplan

1. Klik rustig met uw vinger op de juiste knop

2. Als u een knop aanklikt wordt de knop groen omrand. Ook verschijnt de knop 'ok'. Klik op 'ok' om door te gaan.



3. Vervolgens verschijnt er een nieuw scherm. Geef vervolgens aan hoe u zich voelt door weer met uw vinger op de juiste knop te klikken

4. Als u een knop aanklikt wordt de knop groen omrand. Ook verschijnt de knop 'ok'. Klik op 'ok' om door te gaan.

Guardian

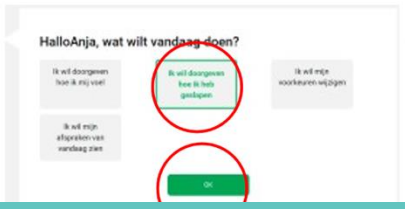
Doorgeven hoe u geslapen heeft

U wilt uw mantelzorger en zorgverlener graag laten weten dat u vannacht goed geslapen heeft en dat ze zich geen zorgen hoeven maken. U kunt daarvoor het tablet gebruiken om dit zelf door te geven. Kijk eens rond welke opties u allemaal ziet en of het lukt om dit door te geven.

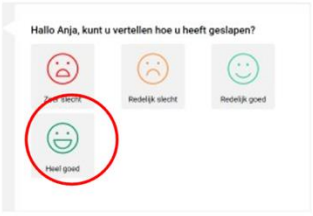
Stappenplan

1. Klik rustig met uw vinger op de juiste knop

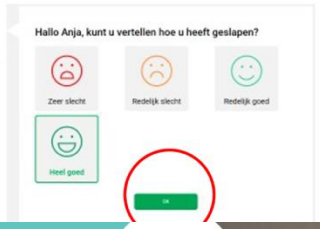
2. Als u een knop aanklikt wordt de knop groen omrand. Ook verschijnt de knop 'ok'. Klik op 'ok' om door te gaan.



3. Vervolgens verschijnter een nieuw scherm. Geef vervolgens aan hoe ugeslapen heeft door weer met uw vinger op de juiste knop teklikken



4. Als u een knop aanklikt wordt de knop groen omrand. Ook verschijnt de knop 'ok'. Klik op 'ok' om door te gaan.



Afspraken bekijken

U wilt weten of u vandaag nog afspraken gepland heeft staan. Uw mantelzorger en zorgverlener kunnen uw afspraken invoeren zodat Floor dit aan u kan doorgeven. U kunt het tablet gebruiken om deze informatie na te vragen.

Stappenplan

1. Klik rustig met uw vinger op de juiste knop

2. Als u een knop aanklikt wordt de knop groen omrand. Ook verschijnt de knop 'ok'. Klik op 'ok' om door te gaan.

3. U krijgt een overzicht met geplande afspraken (in dit geval 0)

4. Gebruik 'terug' om terug te keren naar het hoofdscherr

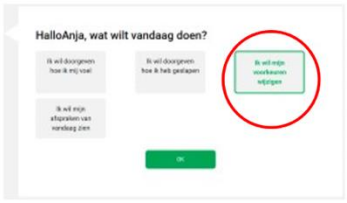
Guardian

Voorkeuren aanpassen

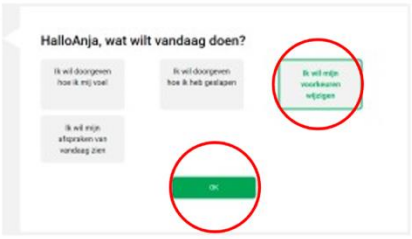
Het kan zijn dat de stem van de robot volgens u te hard of te zacht staat. Dit kunt u aanpassen. Ook kunt u het spreektempo aanpassen en instellen of u liever een mannenstem of een vrouwenstem hoort

Stappenplan

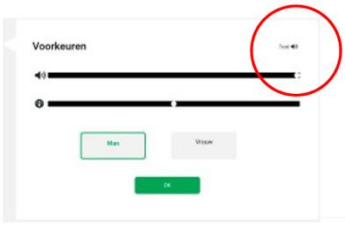
1. Klik rustig met uw vinger op de juiste knop



2. Als u een knop aanklikt wordt de knop groen omrand. Ook verschijnt de knop 'ok'. Klik op 'ok' om door te gaan.



3. Stel uw voorkeurenin en hooreen testberichtdoor op de luidsprekerrechtsbovente klikken.



4. Bent u tevreden?Klik dan op 'ok' om de ingestelde voorkeuren op te slaan.

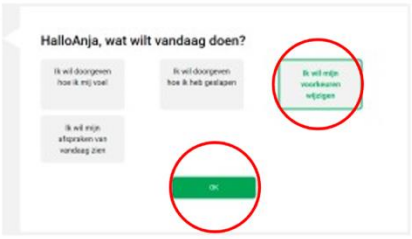
Reageren op Floor

Wanneer uw mantelzorger herinneringen of suggesties heeft ingevoerd kunt u hierop reageren. Luister eens naar Floor wanneer zo'n melding binnenkomt en kijk daarna op de tablet. Hierop kunt u reageren met het gewenste antwoord. Om te reageren moet u het antwoord aanklikken en vervolgens op 'ok' klikken om het antwoord te verzenden

Stappenplan

1. Klik rustig met uw vinger op de juiste knop

2. Als u een knop aanklikt wordt de knop groen omrand. Ook verschijnt de knop 'ok'. Klik op 'ok' om door te gaan.



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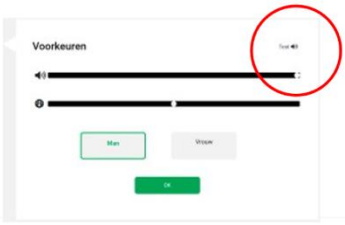


4. Bent u tevreden?Klik dan op 'ok' om de ingestelde voorkeuren op te slaan.

Interactie met Floor

Interactie

Naast de berichtjes die Floor zo nu en dan uitspreekt, kunt u ook zelf de interactie aangaan met Floor.
Helaas kan Floor nog niet goed luisteren en kan zij daarom nog geen mensen verstaan. Wel kunt u de interactie aangaan door middel van aanrakingen en oogcontact.

Aanrakingen

Wanneer u Floor op haar hoofd aanraakt zal zij daar op reageren. Probeer Floor eens op de kin, bovenkant en zijkant van het hoofd aan te raken en bekijk wat dit doet.

Oogcontact

Door middel van de ingebouwde camera kan Floor oogcontact maken en zal ze proberen uw gezicht te volgen om oogcontact te blijven houden. Wanneer het lampje op Floors borst groen kleurt heeft ze uw gezicht herkent.

Floor laten slapen

U kunt Floor laten slapen door op de tablet te drukken op het slaapicoontje. Ook kunt u Floor laten slapen door haar achterhoofd gedurende 3 seconden aan te raken. Floor zal haar hoofd nu laten hangen en slapende ogen vertonen.

Energieverbruik

Gedurende het testen vragen wij u om Floor zo veel mogelijk op de oplader te laten staan. I.v.m. de stijgende prijzen zullen wij u hiervoor compenseren. Aan het einde van het onderzoek zullen we samen met u een declaratieformulier

Floor laten slapen

Stappenplan

1. Klik rustig met uw vinger op de juiste knop

2. Floor slaapt nu en de tablet gaat op onderstaand zwart scherm. Door op 'wake up' te klikken maakt u Floor weer wakker.

Guardian

Werkt iets niet goed?

Als er iets niet werkt,controleer dan:

1. of Floor goed op de oplader staat & de tablet nog voldoende is opgeladen
2. Of er verbinding is tussen de robot, de tablet en zorgverlener applicatie

In de senior applicatie op de tablet staan rechtsonder de volgende symbolen waarmee u kunt controleren of er verbinding is:

= de verbinding met de robot.

= de verbinding tussen de tablet en de zorgverlener applicatie.

Wanneer (een van) beide symbolen rood is/zijn gekleurd (zie hieronder), dan is er iets mis met de verbinding

U kunt dan proberen Floor opnieuw op te starten:

Zet Floor uit met de schuifknop aan de onderkant, wacht 10 seconden en zet Floor weer aan. Wacht ongeveer 5 minuten tot Floor is opgestart.

Worden de symbolen na enkele minuten niet groen in de senior applicatie? Bel dan ICT

Belangrijk informatie (privacy + disclaimers)

Camera

De robot bevat een camera. Deze wordt alleen gebruikt om oogcontact met u te maken, de beelden worden niet opgeslagen. Daarnaast wordt er af en toe een foto gemaakt om te bepalen of u in de buurt bent. Deze foto's worden niet bekeken door mensen en deze worden direct en volledig verwijderd na afloop van het onderzoek.

Microfoon

De robot bevat een microfoon. De robot luistert elk kwartier 10 seconden om te bepalen of u in de buurt bent. Op deze manier weet de robot of een herinnering of verzoek afgespeeld kan worden. Na het uitspreken van een bericht, luistert de robot 5 seconden om uw antwoord te horen. Deze opnames worden opgeslagen, maar alleen gebruikt om uw aanwezigheid te detecteren of het antwoord door te geven. Er wordt niet geanalyseerd wat u zegt. Met deze audiofragmenten wordt verder niets gedaan en deze zullen verwijderd worden na afloop van het onderzoek.

Antwoorden geven

Als u reageert op vragen van de robot door antwoord te geven met Ja/Nee of iets aan te klikken op het tablet worden deze antwoorden zichtbaar in de zorgverlener applicatie Uw mantelzorger en zorgverlener kunnen dit inzien

De robot uitzetten

U kunt ten alle tijden zelf de robot uitzetten als u dat wilt met de knop aan de onderkant. Met deze knop kunt u ook de robot weer aanzetten

Appendix F: Assignment cards awareness session (pre-beta test)

Herinneringen instellen voor eten en drinken

Taak:

U kunt instellen dat Floor de cliënt helpt herinneren aan het nemen van eten en drinken. Bijvoorbeeld dat de robot ‘s middags aangeeft dat het tijd is voor een kop. U kan daarbij ook kiezen of u wil dat de oudere daarbij aan moet geven of hij/zij de actie heeft uitgevoerd.

Kijk hiervoor in het menu bij ‘maaltijden’.

Activiteitensuggesties

Taak:

U kunt instellen dat Floor suggesties doet om bepaalde activiteiten te ondernemen. Stel dit bijvoorbeeld samen met de senior in. Wat vind hij/zij leuk om te doen? Bijvoorbeeld lezen of een stukje wandelen.

Kijk hiervoor in het menu bij ‘activiteiten’.

Taak:

U kunt afspraken van de oudere in de agenda plaatsen. Bijvoorbeeld een doktersafspraak of op bezoek gaan bij de klein kinderen.

Kijk hiervoor in het menu bij ‘afspraken’.

Taak:

Bekijk regelmatig het dashboard en de overzichten om te zien hoe het met de oudere gaat. Kijk bijvoorbeeld hoe het is gegaan met de herinneringen en verzoeken die u eerder hebt ingesteld. Wat valt u op? Het dashboard is een samenvatting van welzijn, slaapkwaliteit, en reacties op herinneringen.

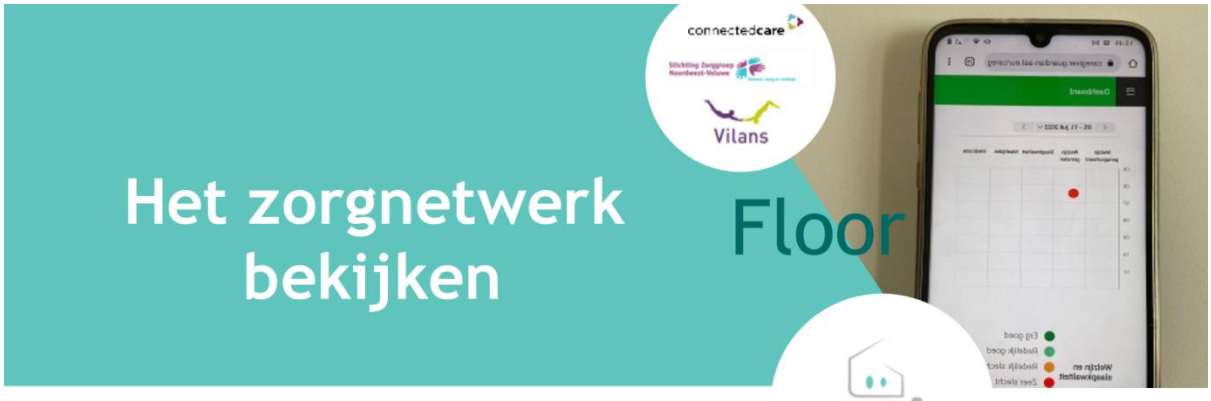
Kijk hiervoor in het menu bij ‘dashboard’. Ook kunt u 'welzijn' of 'slaapkwaliteit' raadplegen voor meer details.

Vragen naar welzijn of slaapkwaliteit

Taak:

U kunt op een door u gewenst tijdstip vragen naar het welzijn en/of de slaapkwaliteit van de senior. Tevens kunt u een vervolgvraag instellen bij verminderde slaapkwaliteit of welzijn.

Kijk hiervoor in het menu bij 'welzijn' of 'slaapkwaliteit'.



Het zorgnetwerk bekijken

Taak:

U kunt het actieve zorgnetwerk van iedere cliënt bekijken. Hier is een overzicht te zien van mantelzorgers en zorgprofessionals. Daarnaast kunt u chatberichten versturen binnen dit netwerk. De cliënt krijgt deze berichten niet te zien.

Kijk hiervoor in het menu bij 'zorgnetwerk.