GUARDIAN

The social robot companion to support homecare nurses

D4.3 Alpha pilot tests results

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1 Executive summary

To evaluate the second prototype of Guardian's system, alpha pilot tests have been conducted in Switzerland, Italy and the Netherlands. Alpha pilot tests were set up to see how the end-users will interact in their daily life, at their home, with the system co-created. These tests allowed us to gather improvements to be included in the third beta prototype, within the allotted time left before ending the project.

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
INCRA	National Institute of Health and Science on Aging
ZNWV	Zorggroep Noordwest-Veluwe

2 Introduction

The alpha pilot tests were initially set up to last three months (as planned in the DoW) but have turned out to be shorter. Indeed, the time of testing had been shortened to one month and a half due to some technical difficulties and the duration appeared to be sufficient for gaining insight into the functionality, usability, acceptance and stability of the alpha prototype. Between March and May 2022, frail seniors have been called on to test a 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 this test had to be available for using the Guardian system for 2 weeks in a group of three (a frail senior, a formal carer and an informal carer). Since then, iterative sessions have been designed to involve participants in a real environment evaluation. Feedback and experiences of all participants were collected through interviews and questionnaires and is used to further develop the third prototype.

2.1 Participants criteria

Formal caregiver inclusion

- Home care nurses, GP's or health professionals involved in the daily/weekly care of a frail senior
- At least 1 year of work experience
- Open mindset towards technology
- Good written and oral comprehension of the local language
- Be available two weeks long

Informal caregiver inclusion

- Relatives or close friends of a senior
- Providing frequent support/care on a daily or weekly basis
- Minimum 18 years old
- Open mindset towards technology
- Good written and oral comprehension of the local language
- Be available two weeks long

Frail senior inclusion

- Being frail and older than 65 years old
- Receiving home care by healthcare professionals daily or weekly
- Basic to advanced level of technology
- Good written and oral comprehension of the local language
- Be available two weeks long

2.2 Participants' involvement

Despite a widespread effort to recruit the intended number of participants for the alpha pilot test (via project disseminations, contact with several home living institutions, flyers distributed, steps-to-follow booklets given to participants) the number of participants couldn't be fully reached in each site.

In total, we gathered a total of 35 participants (13 frail seniors, 10 formal carers, 12 informal carers) interested in testing the robot in a real environment[1]. Without drop-outs a total of 30 participants (10 frail seniors, 10 formal carers, 10 informal carers) have fully completed the test. However, all data have been taken into account to evaluate the system, including the reasons for drop-offs.

[1] In the DoW it is written that we wanted to include 45 participants. The 35 included provided sufficient feedback about the Alpha P2 prototype to enhance the functionality and usability.

As shown in the table below, participants' involvement has been quite different between each partner site. Furthermore (*) are included in the table to point out issues encountered with the disruption of the participants involvement, as originally intended in the protocol.

Table 1: Participants' involvement per site

EU	SWITZERLAND	ITALY	THE NETHERLANDS	Total
FS	4*	5	5	**14**
FC	5*	1*	4*	**10**
IC	3*	5	4*	**12**

Given the circumstances, the reasons (*) will therefore present issues encountered regarding the involvement of participants, site-by-site.

2.2.1 Switzerland

In Switzerland, HUG called for collaboration the biggest home care institution in town, with which we used to collaborate before the well-known Covid-situation. Nowadays, the IMAD staff is still not available because of internal projects they have to fulfil now the situation has returned to normal. When meeting nurses working in the institution, they are very interested in the project but can't follow a patient without the hierarchical approval. To cover the gap, we contacted freelancers or people working on other institutions within the time limit.

Faced with this situation, we had to go directly in contact with frail elderly people. To do so, readable flyers have been created and distributed in institutions - residences for the elderly in Geneva, where seniors live independently but receive visits from carers depending on their needs. 5 seniors have been interested in seeing the robot and testing the Guardian system at their home for two weeks, but only 4 were available for 2 weeks.

Informal carers involved in the alpha pilot test were the ones the frail seniors were already having. We thought we would compensate for the shortcomings by including informal carers and creating brand new triads, but it was a lot to accept for frail seniors who don't want an unknown person having access to their data.

2.2.2 Italy

In Italy, INRCA has been involved to moderate the alpha pilot test. Italian partners succeeded in involving a total of 14 end-users on the alpha pilot test. A first difficulty encountered in recruiting formal caregivers is that in Italy there's no home health care service, so there is no health care professional for the frail elderly. Secondly, health professionals (such as general practitioners, family doctors) to whom people turn when they have needs, do not have a close and exclusive relationship with patients, so it is not possible to identify a professional who knows exactly the needs, the needs of each person. In addition, each general practitioner follows so many patients, so it has not been possible to recruit this category of health professionals because of their lack of time. Finally, the seniors did not accept an outsider knowing their data, so it was not possible to recruit other health professionals to create new triads. Only a formal carer was missing due to those formal caregivers' issues.

2.2.3 The Netherlands

In the Netherlands, ZNVW performed the alpha-tests with support of Vilans. In total, 13 participants were included (4 seniors, 4 informal carers, 5 formal carers) During an awareness session at ZNVW all formal carers were trained on how to use the system and shared their first impressions. Unfortunately, all four seniors stopped alpha testing before they tested the system for 14 days. Main reason for this were technical issues: reminders set by the informal caregiver failed to come through or the system failed to establish a stable connection with the cloud services which caused a malfunction of the complete system. Only one senior was able to test a functioning prototype, but also stopped pre-mature (after 9 days). The participant indicated to have tested all functionalities already and did not think he/she could add anything more.

Because of the faults in the system that could not be solved directly by the technical partners it was decided not to let the last participant start with alpha testing. Instead an demonstration of an hour was organized at the home of the participant to collect an first impression and to keep the participant enthusiastic. This participant will also be the first person to test the third prototype in a preliminary beta-testing this year.

The experiences so far were collected and improvements were added to the Asana (issues) list for the technical partners.

2.3 Participants particularities

In their past careers, most of the seniors were in the field of research, engineering or are simply and particularly interested in the new technologies. All use a computer, or a smartphone, or a tablet, eventually both or all of them. Seniors who haven't dropped-off are mainly those who feel comfortable with digital tools.

Seniors who are used to have technological tools, estimated their technological skills as being low, regarding the Netherlands (2.25/5) and Switzerland, which score's a little bigger (3/5). In Italy (4.6/5), seniors felt very confident with technological tools which could explain the huge involvement of Italian end-users.

Furthermore, participants involved in the three different sites don't have the same profile. In Italy seniors weren't benefited from home care, while in Switzerland it was mitigated and, in the Netherlands, they were kind of dependent on some care provided. This observation can also explain the reasons of drop-offs in Switzerland and in the Netherlands, regarding the situation in Italy.

It can therefore be established that invited frail seniors did not have the same predispositions to use a technological system such as Guardian and that their user experience will be quite different between a site and another.

3 Alpha Pilot Tests' results

Despite the difficulties in retaining or registering participants, all partners managed to obtain some interesting results. The first results will be the inputs of the different questionnaires fulfilled by participants. Secondly some strong points of Guardian's system will be presented. Then, a list of issues/improvements to be done will be presented to notice all the elements end-users would like to see in the system. Improvements pointed out will be a matter of decision between Guardians' partners to evaluate what's feasible to do until beta pilot tests.

3.1 Questionnaires results

3.1.1 Submitted to seniors

Seniors had to fulfil 5 questionnaires in different times: the general questionnaire, IBM questionnaire, ethical questionnaire, SF-12 and the SCI questionnaire. The short duration of testing in the Netherlands and Switzerland made it difficult for participants to fill out the questionnaires and a more qualitative approach was chosen to collect the experiences of the participants.

In Switzerland and in the Netherlands only two frail seniors have been able to respond to the general questionnaire. Regarding the IBM, only one fulfilled it in the Netherlands, still two in Switzerland. The total of frail seniors having fulfilled these questionnaires is 8. The questionnaires have both been ranked with a score of 1 to 7-point scale. [1: totally disagree; 7: totally agree]

General questionnaire

As the system had a lot of technical issues, results from the general questionnaire are quite critical. The system not being able to perform tasks planned and set up, the system has been evaluated as not being stable enough to ensure: medication intake on time, more activities, better meals or hydration, feeling less lonely or becoming more independent. The system's prototype seems not to be a good help for daily routines. One said that he/she had the feeling that his/her daily routine was disturbed by the system more than supported. Nevertheless, the questionnaire points one positive item, as the system seems to have a visible impact on the information provided to carers.

On the ten frail seniors who participated in these tests, only 8 responded fully to the general questionnaire. The results are added to the table on the following page.

Table 2: General questionnaire results

General questionnaire (FS: N8)	
Using Guardian helps me to take my medication on time	3.8
Using Guardian helps me to become more active	2.89
Using Guardian helps me to eat and drink enough	2.25
Guardian system helps me to make me feel less lonely	3.63
Using GUARDIAN helps me to feel more independent	1.88
GUARDIAN helps me to have a daily routine	2.75
GUARDIAN helps me to inform my caregivers about my wellbeing	4.38

IBM questionnaire

When testing the second prototype it has been difficult for seniors to be able to evaluate the IBM questionnaire. On the ten frail seniors who passed the whole test, only 6 gave their opinion on the usability of this technological system. The table below shows the results with scores based on a 7 point-scale [1: totally disagree; 7: totally agree].

Table 3: IBM questionnaire results

IBM questionnaire (FS: N6)	
Overall, I am satisfied with how easy it is to use the GUARDIAN system.	4.7
It was simple to use the GUARDIAN system.	4.5
I could (effectively) successfully complete the tasks and scenarios using the GUARDIAN system.	5.3
I was able to complete the tasks and scenarios quickly using the GUARDIAN system.	5
I was able to efficiently (quickly) complete the tasks and scenarios using the GUARDIAN system.	4.2
I feel comfortable using the GUARDIAN system.	4.2
It was easy to learn to use the GUARDIAN system.	5
I believe I could become productive quickly using the GUARDIAN system.	3.8
The GUARDIAN system gave error messages that clearly told me how to fix problems.	2.8
Whenever I made a mistake using the GUARDIAN system, I could recover easily and quickly.	3.8
The information (such as online help, on-screen messages, and other documentation) provided with the GUARDIAN system was clear.	5.2
It was easy to find the information I needed.	5
The information was effective in helping me complete the tasks and scenarios.	4.5
The organisation of information on the GUARDIAN system screens was clear.	5.3
The interface of the GUARDIAN system was pleasant.	5
I liked using the interface of the GUARDIAN system.	4.7
This GUARDIAN system has all the functions and capabilities I expect it to have.	3.8
Overall, I am satisfied with the GUARDIAN system.	5.3

Ethical questionnaire

It seems that all issues encountered aren't linked to ethical issues. Participants who accepted to take part in these tests, whether they have drop-off or not, were comfortable in using the system. They might be fearing their own abilities to do so, either carers or seniors, but they are not afraid or concerned by ethical questions. On the contrary, they seem to have a lot of confidence in this tool and are reassured to be allowed to see which data is registered by the robot in the seniors' home.

To evaluate the level of the ethical acceptance of the recruited end-users, 5 questions were submitted to participants and ranked with a score on a 5 point-scale.

Table 4: Ethical questionnaire of the APT

ETHICAL QUESTIONNAIRE	
I think that the final product is in line with my expectations (FS: N7)	2
I received enough and satisfactory information to provide my consent and authorization (FS: N9)	5
I feel safe when using Misty (FS: N9)	5
I think that the data collected by Misty are well protected (FS: N9)	5
The robot is not time consuming, but saves time (FS: N7)	4

SF- 12 (12 Item short form health survey) and Frailty Index

In order to evaluate the health of the frail seniors who were hosting the Guardian system, particularly the robot, it was a security to know their state of health. This project has huge interest for frail seniors but the version being a prototype it's necessary for the senior's safety and security to not provide the robot to persons with critical health conditions, where a system bug could be fatal or dangerous.

To evaluate their health, we used two different methodologies: the SF-12 questionnaire (Italy) and the Frailty Index questionnaire (Switzerland and the Netherlands). Both have been ranked to decide if the senior can or can't be accepted as a participant. The Frailty Index has been set up in Netherlands and in Switzerland to assess if the seniors are frail enough to participate in the alpha pilot test. The frailty index is scored 1: yes, 0: no. A score of ≥ 4 indicated the participant was frail.

In contrast, the scores listed in the SF-12 table are scored on a 5 point-scale and affirmative/negative answers have been registered according to the majority.

Table 5: Item short form health survey results

SF-12 (FS:5)	
Evaluate your general health (FS: N5)	2.8
Limitations in doing moderate physical activity (FS: N3)	yes
Limitation in climbing some floor upstairs (FS: N4)	no
In the last week, have you done less than you would due to physical status? (FS: N5)	no
In the last week, have you had limitations in some activities due to physical status? (FS: N5)	no
In the last week, have you done less than you would due to emotional status? (FS: N3)	no
In the last week, have you had focusing problems in some activities due to emotional status? (FS: N5)	no
In the last week, how much has the pain affected your ordinary activities? (FS: N5)	3.4
How much time have you been calm and fine? (FS: N5)	3.8
How much time have you been full of energy? (FS: N5)	2.6
How much time have you been sad? (FS: N5)	1.4
How many times do your emotional and physical conditions affect your social activities? (FS: N5)	1.2

Social connectedness Index: SCI

The social connectedness is evaluated by a 5-point scale, scores are written in the table below. To be sure that seniors will be more linked and sustained by the carers, we ask them to inform on their social connectedness once the system has been used. Regarding the results, the Guardian system improves the connectedness between seniors and their care network.

Table 5: Social connectedness results

SCI (FS:5)	
I feel (in)formal caregivers close to me (FS: 5)	strongly agree (5)
I feel (in)formal caregivers close to me (FS: 5)	strongly agree (5)
I feel supported and understood by the homecare network (FS: 5)	strongly agree (5)
I feel safe with the Misty's care network (FS: 5)	strongly agree (3), little agree (1), don't know (1)

3.1.2 Submitted to carers

General questionnaire results

A general questionnaire has been submitted to formal and informal carers to assess if using the Guardian system will be useful to them or not. Only 5 carers, either formal or informal were able to give a response. The questionnaire is scored [1. Strongly disagree, 5. Strongly agree].

Table 6: General questionnaire results

General questionnaire (Carers: N5)	
Using Guardian helps me to notice something is wrong in an early stage	3.6
The Guardian system offers me peace of mind	3.6
The Guardian system helps me to feel more involved in the care for my loved one	4.2
GUARDIAN helps me to feel more equal in a conversation with a (in)formal caregiver	3
GUARDIAN strengthens the cooperation between caregivers	4

TAM questionnaire results

To assess the technology acceptance of (in)formal careers, the TAM questionnaire has been submitted. Only 5 carers, either formal or informal were able to give a response. The questionnaire is scored [1. Strongly disagree, 7. Strongly agree].

Table 7: TAM questionnaire results

Technology acceptance (Carers:5)	
I find Guardian system easy to use	5.4
Learning how to use technological tool is easy for me	5
It's easy to become skilful at using the Guardian system	5
Guardian system would improve my working performance	4.8
Guardian system would increase my productivity	4.2
Guardian system could make care work easier	4.2
Working through Guardian system is a good idea	5
Working through Guardian system is a wise idea	5
I am positive towards Guardian system	5
I intend to check announcements from Guardian system frequently	5
I intend to be a heavy user of the Guardian system	4.3
I feel confident finding information in the Guardian system	5

3.2 Guardian system's strengths

All frail seniors were pleased by the look of the robot and find the Guardian system pretty useful to get reminders, requests and have some company at home. While using it, some added-values have been pointed out by the seniors like having the possibility to consult their appointments. Furthermore, the seniors indicated to like the possibility to communicate with their care network. One participant in the Netherlands indicated to really like to standard questions of the system and even complies with the suggested activities set by the informal caregiver (e.g. listening to the radio). Frail seniors having used the system the most have been trying to make it work three-four times a day, especially to do self-reports on their well-being and sleep quality (only these two self-reports are available by going through the tablet).

When asking them if they would be interested in paying for such a tool, they mainly responded favourably. Some insisted that it would be interesting to pay for the solutions if it's technically sure of avoiding bugs. By the information provided to them they had to evaluate the price of such a tool. In Switzerland, end-users would agree to pay the whole system 300 euros or will be able to pay 50 euros a month. In Italy, a participant estimated the tool as costing 1000 euros or 10 euros monthly, another said 1500 euros or 75

euros monthly. In the Netherlands, only two seniors responded to this question, both didn't see the benefit of buying it but one of them wanted to contribute with a maximum amount of 50 euros, and have the rest took care by the insurance or care organization.

Table 8: Added-values of the second prototype

ADDED-VALUES LISTED ALPHABETICALLY			
Great network support	**1**	**IT**	The information shared with the network is relevant and provides a feeling of being in security
Buddy companion	**1**	**CH**	It's almost a "human" contact, it's a presence Feels like a buddy because seniors have to take care of it
	2	**IT**	It has some psychological benefits, even if the system is not enough smart to have better interactions with the seniors
Functionalities	**1**	**NL**	It's nice to be able to consult appointments
Willingness-to-pay	**1**	**CH**	300-500 euros or 50 euros monthly
		IT	1000-1500 euros or 10-75 euros monthly

Even if people point out several strengths of the system, they seem not convinced of its usefulness. All of them were interested in the idea of meeting a robot and having one at home, but after seeing its limited interactions, their interest has waned. The main reasons are explained in the following section.

3.3 Guardian system's weaknesses

After a week of use (when no drop-offs), participants were called to check if they encountered any trouble when using the system. At the same time, they were asked what they thought of the system, to which all responded negatively: technical bugs have ruined the experience. (Table: Safety #2). End-users reported that "*the tablet doesn't work correctly*", "*reminders do not work*", "*interaction is too low*", "*robot is fetched after 2 days*", "*the robot kept saying: are you there?*", "*if I am asking something to the robot it doesn't answer*".

Before explaining in detail, the weaknesses pointed out by end-users, a summary table will present the problems and indicate the countries that have encountered them.

Table 9: Issues of the second prototype

ISSUES LISTED ALPHABETICALLY			
Bad user experience	**1**	**CH IT**	Seniors' ID are an error and bad experience factor Example: c0180217-34ea-47ec-9b22-1198g59382iu
	2	**CH**	Senior application has translation issues They should decide the language (c.f. ↗ seniors' actions)
	3	**CH**	The application on smartphone and tablet should be able to use, end-users don't like having to use a computer
	4	**CH**	The robot is too heavy for seniors to carry it Let it on the charging station and unplug if needed
	5	**IT**	The reminders should be postponed when the senior is not at home Difference to make between being at home and not detected
	6	**NL IT**	Sometimes it's hard for seniors to click properly on the tablet and the system can stand by because of the tablet

	7	**NL**	The user manual is not clear enough, should have only important information
	8	**NL**	The camera is too intrusive, they have the feeling of being spied
Interaction	**1**	**CH NL**	The senior can speak to the robot, but it will only look at him/her + the robot only says: *are you there?*
	2	**CH**	The robot can't initiate questions to ask the senior, for example: Oh! Hello [name] do you want to know what's on TV tonight?
	3	**CH**	When recognising the seniors' emotion, the robot should ask a question or sentence regarding its detection: Q: You look angry, what's going on [name]? S: Wow! Seeing you happy makes me happy!
	4	**CH NL**	The robot doesn't make a happy or in love eye expression when it recognises the senior: 😍😊
	5	**CH NL**	End-users do not want to use a tablet anymore The interaction should remain natural: speaking not taping
Limited actions	**1**	**CH**	The senior should easily decide, depending on the robots' questions, who can reach the information gathered by the system
	2	**CH**	The senior should be able to enter his/her own appointments on the tablet, it's complicated and frustrating to go through somebody
	3	**CH**	Be able to know who put the reminders/requests and be allowed to enter in contact with them through Guardian system
	4	**NL**	Activity suggestions are not available in the tablet but should appear like the appointment's functionality
	5	**IT**	Seniors should be able to do more self-reports than only saying how they are doing and how they have slept (medication, meal self-reports)
Safety	**1**	**CH**	Feature to know if the senior has fallen is not available Can it at least be connected to home automations which detect falls?
	2	**CH**	Seniors can be in danger if frail and needing some reminders and requests to continue living properly
	3	**CH**	Guardian system can't recognise the senior if he/she stands more than 2 metres far away
	4	**CH**	The system is not helping them to better understand their treatment The senior application should have some practical information
	5	**NL IT**	Hard to keep both tablet and robot on charge, if tablet is not on charge the senior is disconnected and won't receive anything

3.3.1 Poor ways of interaction

Most of the seniors or (in)formal carers thought that the robot would talk more. They are a bit disappointed to have to set up all the interactions to hear its voice. Some automatic robot actions should be implemented on the Guardian system to make it more alive, for example not only stare at the senior, but once it detects its presence, it could say something; or the robot should be able to answer to basic information which can be helpful on the seniors' daily life (Table: Interaction #1, #2)

During the installation of the robot and when presenting the skills of emotional recognition, a question often ends up being asked: will it ask me why I am sad if it sees me with a sad face? The answer always

ends up disappointing them and they no longer understand the purpose of such a feature. Those who have tested the Guardian system at home haven't noticed any change of emotion in the robot, they also request a robot being able to change its visual expressions more often. (Table: Interaction #3, #4)

When testing it, seniors either (in)formal carers are disappointed to have to use a tablet to interact with the robot. Nowadays AI is well known to the public, and end-users seem to have a good acceptance of AI because it seems easier to use. The Guardian system therefore does not coincide with their expectations. (Table: Interaction #5)

3.3.2 Bad user experience components

The ID of the senior is way too long and complicated; seniors should be able to connect themselves in an easier way and create their own account. Although in the Netherlands, the team did it for them so it wasn't a problem for the elderly. (For people who are not used to using a keyboard, even less so if it is tactile, it is complicated to alternate between numbers, letters and symbols to enter their ID. Furthermore, they should be able to create their own name profile and write it instead of the complicated code given through the management application. (Table: Bad user experience #1)

The tablet displays self-wellbeing and sleep quality reports in another language. The translation issues put participants in a bind because even if they understand what is expected from them, it is confusing to see two languages mixed on the same application. Moreover, the seniors should be able to change the tablet's language. In Geneva, there are many different nationalities, and some are more comfortable with their mother tongue, so it would be appropriate to offer seniors the choice of language. (Table: Bad user experience #2)

The application on smartphone and tablet should be able to be used, end-users don't like having to use a computer. The project was developed to make carers earn some time to ensure quality in the care provided, so it would be less time consuming and convenient to be able to set the system up directly through a smartphone instead of a computer. (Table: Bad user experience #3)

The Guardian robot must be on charge while using it as it's too heavy for seniors to carry it and put it safely on the charging station. To solve this issue, participants let the robot on the station and just unplug it. (Table: Bad user experience #4)

The reminders should be postponed when the senior is not at home but the robot has to know clearly if the senior is out of home or if it's not capable of detecting him/her because of the distance. (Table: Bad user experience #5)

Seniors who aren't used to tablets encounter difficulties to use it, such as simply clicking on it. Moreover, sometimes they might forget they have to charge the tablet and if it's not charged, it's not connected which won't allow the system to work. For many reasons, the tablet is pointed out as not necessary and desired. (Table: Bad user experience #6)

To help seniors to go through their difficulties, the user booklets given haven't been enough. There was a lot of information on them but not everything was necessary. Moreover, rather than a qualitative booklet, participants should have more than an informative session to get accustomed to how the system works. (Table: Bad user experience #7)

Some feel that even if they are aware of technology, they wouldn't always be able to operate the system by themselves as it is now. Only a few find it relevant for their situation and health condition. After using it, a participant said "*I don't like it, it feels like those big eyes are following me the whole time. It feels intrusive*". This feeling is shared by others who say "*I have the feeling of being spied on*", while most initially did not see a robot as ethically problematic. (Table: Bad user experience #8)

3.3.3 Limited seniors' actions

To enhance the interaction between the robot and the senior but also to make sure that the senior stays in control of the robot's action and rights to access his/her data, a human characteristic and custom should

create a sense of trust: tell the robot to keep it secret. For now, it's the administrator who can activate or deactivate modules, or the carers either formal or informal, but the seniors' actions are limited. If the aim was to ensure seniors' independence by giving them the security of being in control of their data access, there is an important feature missing here. (Table: Limited actions #1)

The system, as it's now, limits the independence of seniors who aren't allowed to add simple appointments to their daily pattern. It's complicated for them to join carers and ask them to add or be dependent on the dates put on the robot without being in control. All seniors have been annoyed by this missing feature, which make them feel as they are not able to remember by themselves or trustable anymore (Table: Limited actions #2)

Seniors don't have information on who is sending the reminders, requests, or their carers couldn't know who to contact in case of issues. For now, it seems that only carers are allowed to start the interaction or dialogue with the seniors when it should be the opposite. (Table: Limited actions #3)

Seniors should be allowed to set up or consult the same functionalities their carers can set up. In their tablet, and to justify its use, activity suggestions should be available directly through the tablet. If they can consult their appointments, why not their activities suggestions, medication reminders set up, meals, etc. (Table: Limited actions #4)
For now, seniors don't find the tablet as being relevant to use, but it could be more interesting for them to use it if they were able to do more self-reports than only saying how they are doing and how they have slept (medication, meal self-reports). For some seniors, using the tablet is more difficult than using the robot. If they can't use the tablet or maintain it on, their actions with the Guardian system will be restricted. (Table: Limited actions #5)

3.3.4 Future recommendations

Regarding informal carers, the Guardian system for now sets aside the fall detectors. For them, having a presence at the seniors' home is also a way to control falls or risks of falling because the requests for wellbeing can be made by calling them and the reminders can be set with other systems that are easier to use (application for smartphone/tablet which allow to set reminders). In the future, linking Guardian to a fall detector they already use would be a nice value to strengthen the project (Table: Safety #1)

As the system has been set up for frail elderly people, it must be ensured that the system works and that reminders, requests and suggestions are generated within the time allowed by the carers' plans set up. If those features do not appear in time and the elderly wait on it, their health condition could worsen due to a malfunctioning system. Frequently, these are not generated until the elderly person opens the application and tries to communicate on their own through self-reports. (Table: Safety #2)

It's also not very secure to know that Misty can't recognise anyone at more than 2 metres. It then seems that some reminders or requests do not come over if it doesn't see the senior, so the senior feels forced to stay in the same room as the robot. They are afraid of missing reminders or requests, one solution would be to make it move around, even if it will maybe cause falls. Project partners should not choose for seniors and let them decide if they want the robot to follow them or to stay in a table (Table: Safety #3)

The system should pass an info button for medication to limit risks of errors, like a pop-up message with an image or with important information needed to be heard by the senior. The senior could have an image appearing to know which pill to take or they can have simple but practical information on the medication they take. Having well-informed patients increases the system's safety and gives them the chance to become the main actor of their health. (Table: Safety #4)

Having to use a robot and a tablet is too much to accept for some seniors who are not sure to be able to use a tablet. Few seniors have very high expectations regarding these robots, imagining that they can talk by themselves and offer them more interactions, more independent. They are then less motivated to keep a system “alive” by charging robots and tablets all the time. Being less motivated can lead to drop-offs, which occurred in the Netherlands and in Switzerland, and could maybe lead to health issues if the seniors were too frail. In Italy, a senior suggested being notified by a sound or a message when the system is not connected anymore. (Table: Safety #5)

3.4 Next steps

We collected the first experiences of the participants with the Guardian system during the alpha testing. The feedback was added to asana and discussed during the technical meetings. Additionally, it was input in the consortium meeting in Geneve, where was decided on the next steps of development. This resulted in a list with future improvements and recommendations which are for this project out of scope and a list with new features, improvements of existing features and bug fixing important for the third prototype.

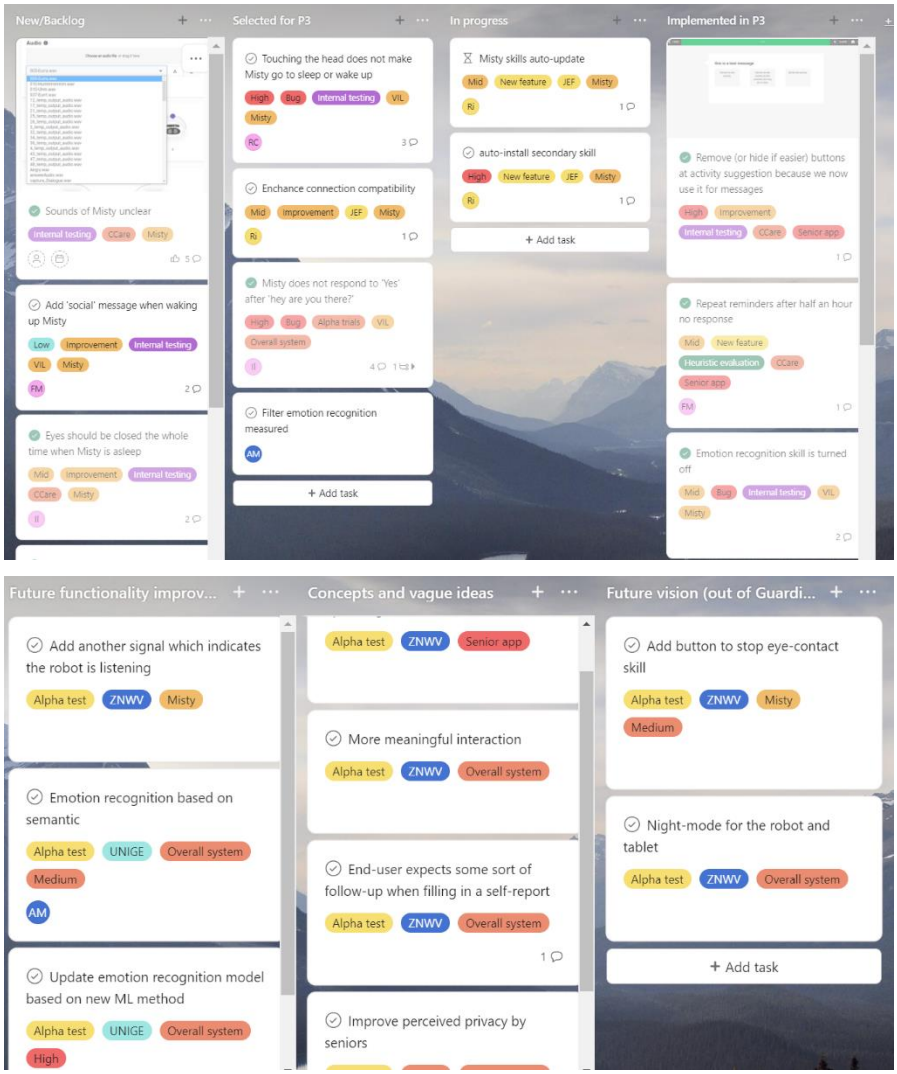

Figure 1. Example of the list of new features, improvements and bug fixing contained during alpha testing.

4 Conclusion

Unfortunately, due to some technical issues and difficulties with recruitment of participants alpha testing was not completely performed as planned. Nevertheless, a lot of useful feedback was collected on the usability and functionality of the system and used to decide how to further design and develop P3 of Guardian.

We should rethink the involvement phase for the next and last beta evaluation. To do so, an entire month (M31) should be dedicated to inform potential end-users by presenting them the robot beforehand and give them enough information, so they do not idealise the robot but understand how it really works (T0). It's probable that some issues can be apprehended by informing the participants correctly on the available functionalities and skills of the robot. This new methodology should then already ensure a smoother beta pilot test.

To have end-users informed properly, meetings will be created in the participating care organizations (INRCA, HUG & ZNWV) to show how the robot looks like, how it can be connected and controlled through Misty App and explain to them the aim of Guardian's project and what has been achieved so far. To ensure that the information in our presentation will be retained by the frail seniors, a new small leaflet will be distributed to them. This one will gather the main points to keep in mind before making the decision of participating in these kinds of tests. This leaflet should be available for the recruitment period in July (M31), so participants can browse it directly at home until the test handover. Once the seniors are using the Guardian system at home, they should also keep a booklet as in the APT, but this time it should be shortened with practical information.

Once the installation is done (T1), a call should be set up the day after to ensure that the system doesn't encounter any issues and that all requests and reminders are correctly driven by the system. Waiting a week was definitely too long, few participants dropping already after only days of use.

Those modifications should help to limit the issues of the testing and the third prototype should be at least working efficiently & effectively in reminders and support of day structure - with social interaction features - to maintain participants involved in the pilot tests and obtain more qualitative insights. Regarding the issues gathered by the end-users' perspectives, choices will be made to offer an improved version as far as possible. Nevertheless, it should be borne in mind that choices need to be made in development due to timing and financial constraints - i.e. not all design and interaction requirements can be included in P3 - before the launch of the beta testing phase in September 2022 (M33).

5 Appendix

5.1 The Frailty Index

Objective

The vulnerability of (older) patients largely determines the risk of hospital complications. You can determine the vulnerability of the patient with the help of the GFI: the Groningen Frailty Indicator. This questionnaire contains 15 questions, all relating to the following 7 areas of vulnerability: Mobility, Cognition, Observation, Nutritional status, Co-morbidity, Social status and Mental state.

Method

To determine the vulnerability of an elderly patient (≥ 70 years), 15 specific questions are asked. The questions cover (1) the patient's situation in the past month, (2) the situation before the patient became seriously ill. If the patient cannot answer these questions on their own, ask the next of kin. Score the total. A total score ≥ 4 indicates a vulnerable patient. Vulnerable patients are further assessed in accordance with the agreements made in this regard. Patients should circle the most appropriate answer.

Table 10: Frailty Index passed in the Netherlands and in Switzerland

FRAILTY INDEX (FS:9)	
Can you go shopping independently?	
Can you move around outside the house completely independently (around the house or to neighbours)?	
Can you dress and undress yourself completely independently?	
Can you get to and from the toilet completely independently?	
If you were to give a score for your physical fitness, where 1 is very bad and 10 is excellent, what would that mark be?	
Do you have any complaints about your memory?	
Do you have problems in everyday life because of your poor eyesight?	
Do you experience problems in everyday life because of your hearing loss?	
Have you lost a lot of weight in the last 6 months without wanting to?	
Are you currently taking 4 or more types of medication?	
Do you ever feel a void around you?	
Do you ever miss the people around you?	
Do you sometimes feel abandoned?	
Have you been feeling gloomy or depressed lately?	
Have you felt nervous or anxious lately?	