ELF@Home

Elderly sELF-care based on sELF-check of health conditions and sELF-fitness at home

D6.3 User Trials Report

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Deliverable nature:	Report
Dissemination level: (Confidentiality)	P
Contractual delivery date:	31 May 2016
Actual delivery date:	16 August 2016
Version:	2.0
Total number of pages:	48
Keywords:	Trials, users, exercises, fitness programme, prototype

Abstract

This report presents and summarises the results of the user trials conducted so far (until end May) with the ELF@Home final prototype in Spain and Sweden. Due to delays in integrating the complete system, we have not yet been able to trial the system in use with many users, and the activity sensor component is as yet not fully integrated. Users in Sweden were generally more enthusiastic about using the system than those in Spain. This document reports usage and health data collected from the system as well as comments on the prototype from our users so far. We will continue to install and trail with additional user over the summer.

[End of abstract]

Executive Summary

This report presents and summarises the results of the user trials conducted with the ELF@Home prototype in Spain and Sweden.

Task 6.2 covered the specification of trials and user selection, including definition of the trial set-up, the variables to be collected, the methodology used to collect user impressions and the selection of a representative set of users. These were reported in detail in D6.2: Trial definition report (M29).

The main sections of this report are as follows:

Section 1: Introduction

Section 2: Trials Methodology

Section 3: Main Field Trial Results (Spain)

Section 4: Supplementary Trial Results (Sweden)

Section 5: Conclusions

References

Annex A: Exercise performance data

Annex B: Health status data

Annex C: Photos from the trials

The complete integrated prototype was ready later than planned, due to technical factors, and so the trials were started later than anticipated and are still in progress at the time of this report. Additionally, it was found that the main trial users in Spain were unwilling to test the Activity Sensor (AS) component, due to its perceived complexity of use. In Sweden, the users were more willing to try this component, but technical problems meant that we were unable to compile any results on this.

The Swedish users believe that the ELF@Home system is necessary for seniors and that it would be a good aid in a senior's everyday life. However, in order for it to actually be a part of their everyday life the system has to have contact with a medical team that verify and adjust it to the specific user and who has responsibility for the user's health. The users have many times stressed the need for a medical team that can check the health status and to see that the exercises are custom made correctly for each individual user.

So far, we have not been able to expose the test the many users, but we are continuing with this activity and expect to more results later in the summer. Some of the seniors in Åsele are going to share a prototype in one of their homes and do the exercises together. They feel that this is advantageous social interaction and mutual encouragement and support.

This is an updated version of the deliverable, which contains more data related to the user trials that continued after the official end of the project.

Document Information

Acronym	ELF@Home
Full Title	elderly sELF-care based on sELF-check of health conditions and sELF-fitness at home
Project URL	http://www.elfathome.eu/
Document URL	

Deliverable	**Number**	D6.3	**Title**	User Trials Result Report
Work Package	**Number**	WP6	**Title**	Integration and Field Trials

Date of Delivery	**Contractual**	31 May 2016	**Actual**	M36
Status	version 2.0		final ☑	
Nature	prototype □ report X demonstrator □ other □			
Dissemination level	public ☑ restricted □			

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Keywords	Trials, users, exercises, fitness programme, prototype

Version Log			
Issue Date	**Rev. No.**	**Author**	**Change**
2016-05-19	0.1	John Waterworth	Initial structure and content
2016-05-25	0.2	Sonia Garcia	Content added
2016-05-27	0.3	John Waterworth	Content added + structural changes
2016-05-29	0.4	Eva L. Waterworth	Content added
2016-05-30	0.5	Sonia García	Content added
2016-05-30	0.6	Stefanie Erdt	Review
2016-05-30	1.0	John Waterworth	Final version
2016-07-18	1.1	Sonia García	Content added
2016-08-02	2.0	John Waterworth	Final version

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Abbreviations

EUPE: Evaluation Unit and Planning Engine

ICT: Information and Communication Technologies

AS: Activity Sensor

1 Introduction

This report presents and summarises the results of the user trials conducted with the ELF@Home prototype in Spain and Sweden. This is an updated version of the deliverable, which contains more data related to the user trials that continued after the official end of the project.

The complete integrated prototype was ready later than planned, due to technical factors, and so the trials were started later than anticipated and are still in progress at the time of this report. Additionally, it was found that the main trial users in Spain were unwilling to test the Activity Sensor (AS) component, due to its perceived complexity of use. In Sweden, the users were more willing to try this component, but technical problems meant that we were unable to compile any results on this.

Task 6.2 covered the specification of trials and user selection, including definition of the trial set-up, the variables to be collected, the methodology used to collect user impressions and the selection of a representative set of users. These were reported in detail in D6.2: Trial definition report (M29).

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2 Trials methodology

2.1 Initial user groups and recruitment

2.1.1 Spanish primary user groups

The Spanish primary user test population consisted of two groups: The SGGPA group consisted of 10-15 users, with a 2:1 ratio of female:male, and an average age 80. They have chronic health conditions but no cognitive impairment. The MANCOSI group consisted of 23 females and 1 male, with an average age 85, living in rural, sparsely-populated areas

Both groups were characterised as physically inactive.

2.1.2 Swedish primary user groups

The Swedish primary user test population was also composed of two groups: The Skellefteå group consisted of 12 users, 8 females and 4 males, with an age range of 70-85 years. They live independently, mostly in the town of Skellefteå or the surrounding areas. The Åsele group consisted of 15 users, 10 females and 5 males, with an age range of 65-87years. They live independently, mostly in the small town of Åsele or the surrounding rural areas.

Both groups were characterised as physically active in general, though most have some health issues.

2.1.3 Users' recruitment

The Barthel Scale [2] was used for selecting users to take part in the field trials. It is a test used to measure users' performance in activities of daily living (personal hygiene, dressing, eating...). If a user had a low index on this scale, she may well not be able to use the ELF@Home System because it would be very complex for her, whereas a user with a high index in the Barthel Scale would be able to participate in the field trials.

2.1.4 Final User groups

The user groups defined in section 2.1.1 were the users that were initially selected as possible candidates for testing the program. However, not all the users were able to test the prototype, because the tests started later than expected, due to different problems with the prototype.
As it was stated in D6.2, the Swedish users were expected to evaluate at home the usability and technical feasibility of the ELF@Home solution whereas the Spanish users would evaluate the prototype with medical supervision.

2.2 Installing equipment and conduct of trials

Before installing the equipment, a second introduction meeting was carried out to present again what is going to be done and conduct the pre-tests and the first interview. Another visit was made to install the equipment and demonstrate it. The users were encouraged to handle the prototype themselves to gain familiarity with it. After 2 days, we checked that the prototype was working and that the user remembered how to handle it.

Fitness of users was measured using the Short Physical Performance Battery (SPPB) [3] to evaluate lower extremity functioning. The result of this test is highly related to frailty, mortality and cognitive impairment (see Deliverable D6.2). The SPPB test was used for evaluating performance in balance and in gait speed. Users carried out this test at the start of the field trials and at the end, to determine whether their performance had improved.

Users were monitored during trials to check if they were having problems with the ELF@Home solution and to try to solve these as soon as possible.

After half of the test period, another meeting was organized to conduct the intermediate tests and interviews in users' homes.

When the trials were finished, the final tests and interviews were carried out. The SPPB test was repeated to evaluate any improvements from using the ELF@Home solution.

A final group meeting with all users was organized, at which the trials were discussed.

2.3 What has been tested

Each user was given a personal NFC-card that they used to log into the prototype. Previously UMU and SGGPA staff had included the users in the database so the Intelligent Service Platform created personalized exercises schedules for each user, which were updated on a weekly basis.

The users were able to test the indoor exercises and the health measurement process (as each of them were given a pulseoximeter and a blood pressure monitor). Nevertheless, the outdoor exercises were not yet tested because:

- The Spanish users did not want to test it: they thought it was too complex. They stated that they had enough instructions to remember to learn to use the prototype and they did not want to use more things.
- The Swedish users wanted to test it, although some unexpected problems happened with the activity sensor at the end of the project. When they were solved the device worked correctly but there were some problems found in the process of sending the data to the database. This meant that the outdoor data should be recorded but could not be transmitted. The users were told that they could test the AS but that due to some technical problems they could not see their results of their outdoor activities.

2.4 Results collected

2.4.1 Unstructured interviews and focus group results before the trials

Unstructured interviews were conducted with potential users before the trials commenced (see D2.1), and throughout the early components tests (see D3.5 and D4.4).

As detailed in D2.1, all of the Swedish users liked the project idea, before having experience of the prototype and think it is very important for elderly people to keep both physically and mentally active and fit. They were very interested in their own fitness and wellbeing. All of the users indicated that they would consider doing exercises in front of a TV as long as they can see the benefit of the exercises - if it is “fun” and motivating. They also could see an advantage from being able to see their results in terms of fitness.

In discussion meetings, the following points were raised:

- One of the most important tasks of designing a usable home-fitness system for the elderly is to design it so the users overcome the threshold of starting to do exercises, and to make the exercises fun so that they see the advantages of exercising.
- How the results are shown is also important and how this can help the elderly feel motivated to exercise.
- Ethical issues are important to them, mostly as regards their privacy. They want to know who is going to have access to their personal data apart from themselves. The ideal situation for them would be that doctors, nurses and their physiotherapist have access and can if necessary advise or take care of an acute situation. The physiotherapist could evaluate their exercises and correct them.
- During this discussion it was also suggested that it would be advantageous with a healthcare centre that is only for elderly and that could be connected to the ELF@Home system.

When users had completed their trials of the final prototype, unstructured interviews were again carried out, this time focusing on their experiences with the prototype itself and their reflections on that and on health and exercise in general.

2.4.2 Results collected during the trials: System Use and Performance

The best way for knowing if the users used the system is to analyse the number of executions they did in each session. As all the users start from level 1, as defined in document D2.1, the indoor schedule that they will have to do will consist of 6 different exercises randomly chosen. Each of the exercises for level 1 should have 2 series and 8 repetitions. So in each session of ELF@Home, the user should have completed 16 executions of each exercise.

Nevertheless, in several cases, the number is lower because the users can skip exercises in 2 cases:

- If the prototype does not detect any correct movements for a certain period of time it will prompt a message to the user with the message "You seem to have problems with the exercise, do you want to keep trying or do you want to skip this exercise?"
- The users can say the audio command "skip" when they want. They are told that they should not use this command but they wanted to have this command in case they don't know what to do.

As a result, the number of executions in each session is different for each user.

Other data that can be analysed are the scores obtained for each exercise. With this data we should know which exercises are the most difficult for them or if there are any exercises too easy. The exercises are graded analysing the different angles of certain parts of the body and/or the duration of the exercise (the conditions are different for each exercise). But it has to be taken into account that there are several exercises that cannot be graded by the system because the user can only do it correctly or not (for example, in the "standing from a chair" exercise, the user has to follow some steps such as sitting down, standing up, lifting his arms… but the speed is not important in this exercise). As a result these exercises will have a score of 100 and the rest of the graded exercises will have a score from 0 to 100.

2.4.3 Unstructured interviews and focus group results after the trials

After the trials users were asked about their impressions on the use of the prototype. The results are discussed in sections 3.6 and 4.6 of this document, as they are different in Spain and Sweden.

3 Main Field Trial Results (Spain)

3.1 Users selected

In Spain there were two user groups, selected by MANCOSI and SGGPA.

3.1.1 MANCOSI

MANCOSI selected 3 users: 1 of them lives in the town of Villaviciosa in Asturias and 2 of them live in a rural area near Villaviciosa.

Table 1 shows the main characteristics of the users selected: the number the system uses for their identification, if they are males or females, their age and the interval during which they used the prototype. All of these users lived on their own and they are quite active physically, as they go several days a week to gym classes specific for older people.

Id	M / F	Age	From	To
263	F	67	18/03/2016	03/04/2016
264	M	67	18/03/2016	03/04/2016
265	F	76	22/03/2016	19/04/2016

Table 1. Spanish users (MANCOSI)

3.1.2 SGGPA

SGGPA works with several caregiver institutions and they selected OVIDA for the trials. OVIDA is an intergenerational centre located in Oviedo (Asturias). Figure 1 shows the main building of OVIDA.

Figure 1. OVIDA intergenerational centre

OVIDA is a large centre that offers several services:

- Residence for the elderly (2 users share a room that has all the medical equipment needed in case they have movement problems). An example of a room of the residence can be seen in Figure 2.
- Individual apartments for older people (they live on their own but they have meals service included and medical attention service included). Figure 3 shows an apartment.

- Day care centre for older people
- Students residence
- Courses

Figure 2. OVIDA – Room of the residence section

Figure 3. OVIDA – Apartment

Two groups of users were selected by OVIDA:

- "Residence group": Users that were on the residence for the elderly
- "Apartment group": Users that live on their own apartment

It was expected that the users in the residence group needed more help than the users in the apartment group, so for the residence group an ELF@Home prototype was installed in a common room of the residence. OVIDA caregivers were always with the users during the trials, they had to help them sometimes and guide them through the exercises. In Figure 4 an example of a user using the prototype in the residence group can be seen.

Figure 4. User from the residence group

The users in the apartment group initially tried the prototype in an empty apartment in which it was installed. Then, the initial idea was that a prototype would be installed in their own apartment, but this could not be finally done, mostly because:

- The users did not feel confident about using the prototype on their own, they like always to have a caregiver with them in case they do not know what to do.
- They don't have much space in the apartment to do the exercises in comfort.

So finally these users used the prototype in the empty apartment (see Figure 5).

Figure 5. User from the apartment group

In Table 2 the main characteristics of the OVIDA users are shown:

Id	M / F	Age	From	To	Group
270	M	83	30/03/2016	30/06/2016	Residence
271	M	87	30/03/2016	30/06/2016	Residence
272	M	92	30/03/2016	30/06/2016	Residence
273	M	66	30/03/2016	30/06/2016	Residence

274	F	65	30/03/2016	30/06/2016	Residence
279	F	84	22/04/2016	30/06/2016	Apartment
280	F	80	22/04/2016	30/06/2016	Apartment
281	M	85	22/04/2016	30/06/2016	Apartment
282	M	87	25/04/2016	30/06/2016	Apartment

Table 2. Spanish users (OVIDA)

For the creation of this document, we have only taken into account the data until 22/05/2016 to be able to extract the data from the database and get some results. But people from OVIDA continue using the prototype and they will continue doing tests with these users even after the project officially ends.

3.2 Exercise frequency and scores

The total number of exercises executions that were done during the Spanish trials were 6283 executions (see Table 8 in Appendix A).

Figure 6 below, shows the distribution for each exercise of the total of executions that were carried out in the Spanish trials.

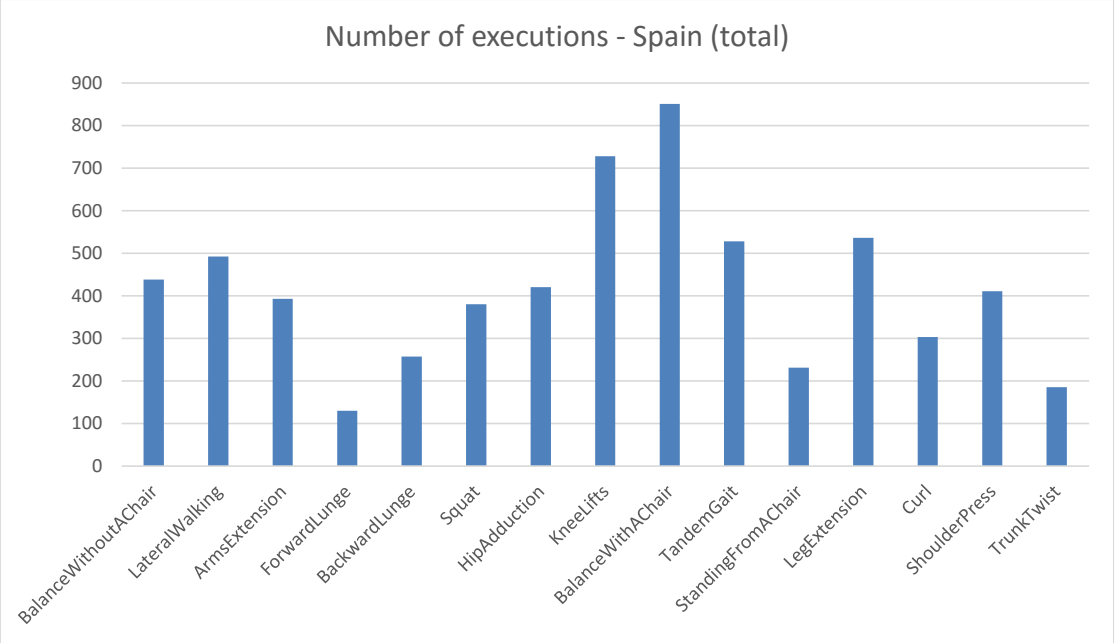

Figure 6. Number of exercises carried out (all Spanish users)

In Figure 7 the average performance of all of the exercises is shown.

If we consider only the exercises that can be graded (i.e. the exercises that have an average score lower than 100), the exercises in which the users had a lower performance were the “Balance without a chair” and “Balance with a chair” exercises, showing that users have problems with balance. On the contrary, the exercise they perform better is the “Knee lifts” exercise.

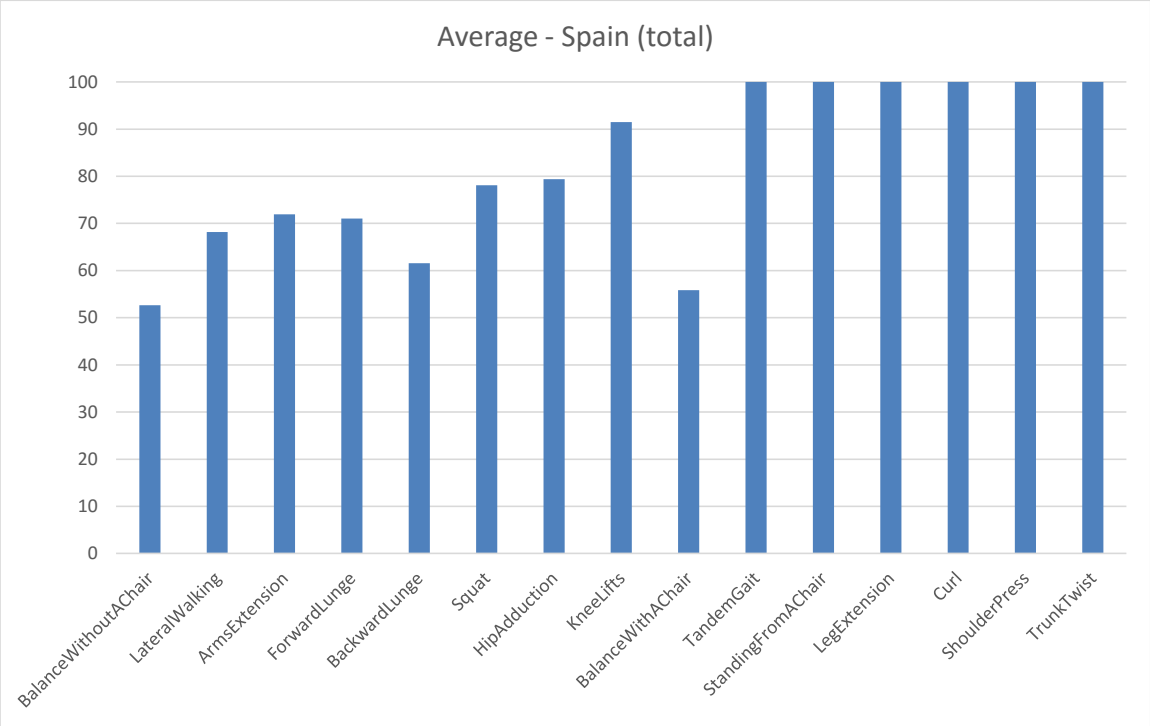

Figure 7. Average scores on the different exercises (all Spanish users)

3.3 Navigation mode (gestures, voice)

Spanish users preferred to navigate using the voice. All the users have agreed on this. They stated that they felt more confident using the voice because sometimes they may have problems selecting a button with a gesture.

3.4 Problems reported

The main problems in the Spanish trials were related to the connection of the health sensors. As the fitness-boxes were different in Sweden and in Spain, the Bluetooth version was different and sometimes the sensors did not send the data, or it was not received by the fitness-box. This implies that apart of having less data for the health status in the Spanish trials, the users did not like that this functionality did not work as expected because they have to be waiting until a measure is read and they get tired of waiting until the application shows them a "timeout" event and lets them continue with their tasks.

3.5 Health Status

Health status was measured by the users themselves, and recorded automatically by the system.

This section shows some examples of the measures of different users and more examples are given in Annex B. In some cases, for the same day, two measures are shown in the charts, meaning that the users were told to repeat the measurement process.

3.5.1 Heart rate data, before and after exercise

The heart rate after doing the exercises is expected to be higher than the heart rate taken on the same day before going the exercises. Figure 8 below shows the measures recorded for User 264 and, as it can be seen, in general the "after" values are higher than the "before" values. Nevertheless, this condition is not always met: in certain days these two values are almost the same and in other days the "after" value is lower than the "before" value. If the user continues using the prototype for a longer time, the prototype would detect this situation and it would increase the number of the quantity of exercise so the user would have to do more physical effort.

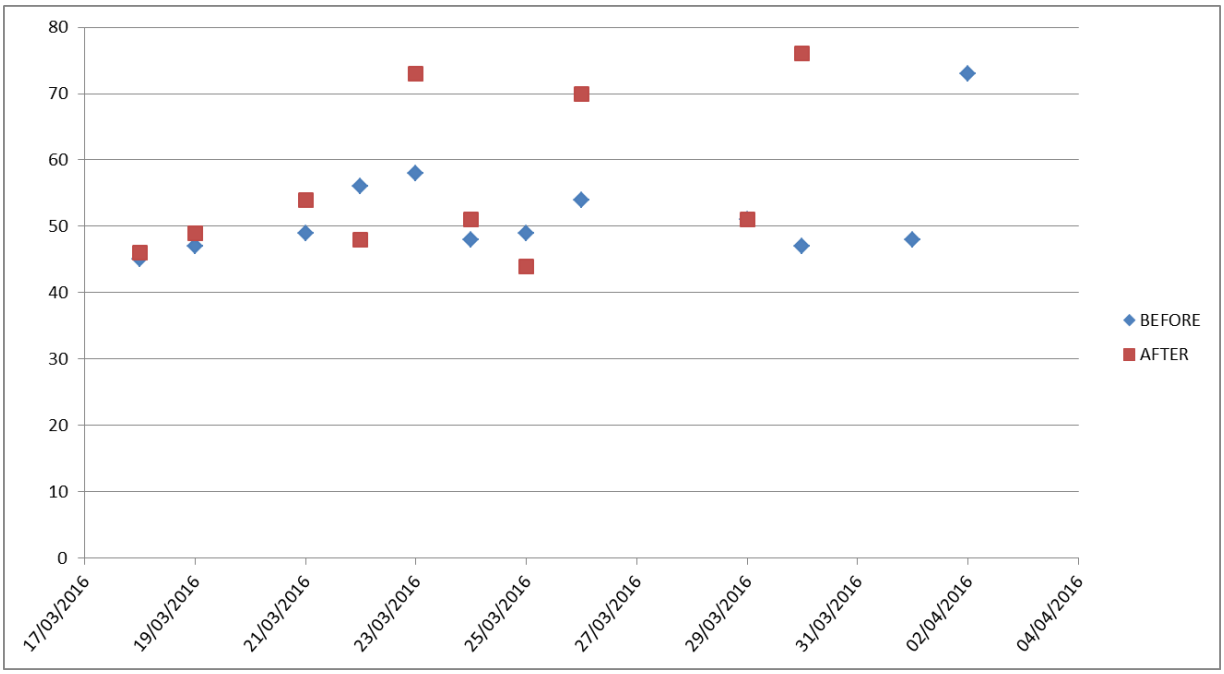

Figure 8. Heart rates taken before and after exercise (User 264)

3.5.2 Oxygen saturation

Figure 9 shows an example of readings taken of oxygen saturation from one user (User 279). In this case, the values do not change much and we show only the before readings in the figure.

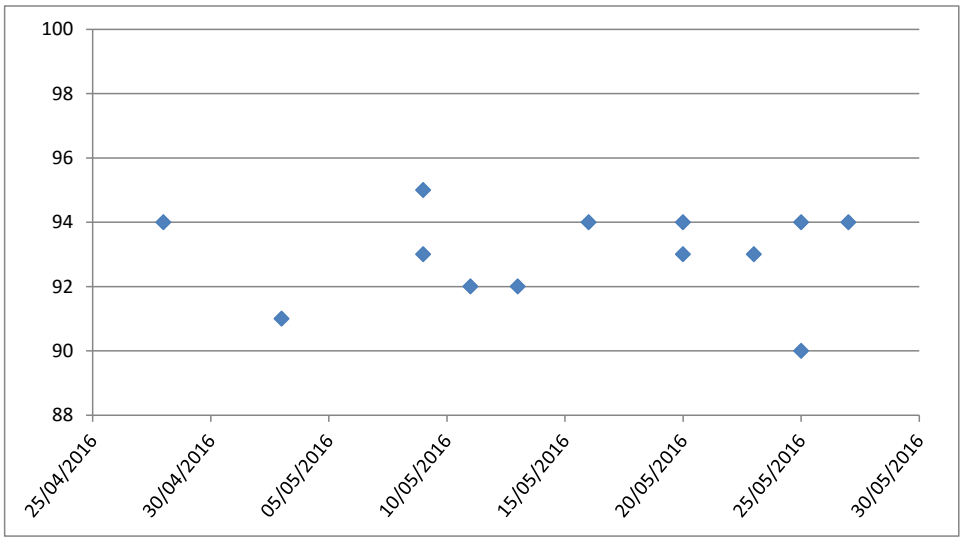

Figure 9. Example oxygen saturation readings (User 279)

3.5.3 Blood pressure

Figure 10 shows an example of blood pressure readings taken over a period of time using the prototype. In this case, the blood pressure should not have differences before and after the exercises, so we show the values for a user before the exercise as an example.

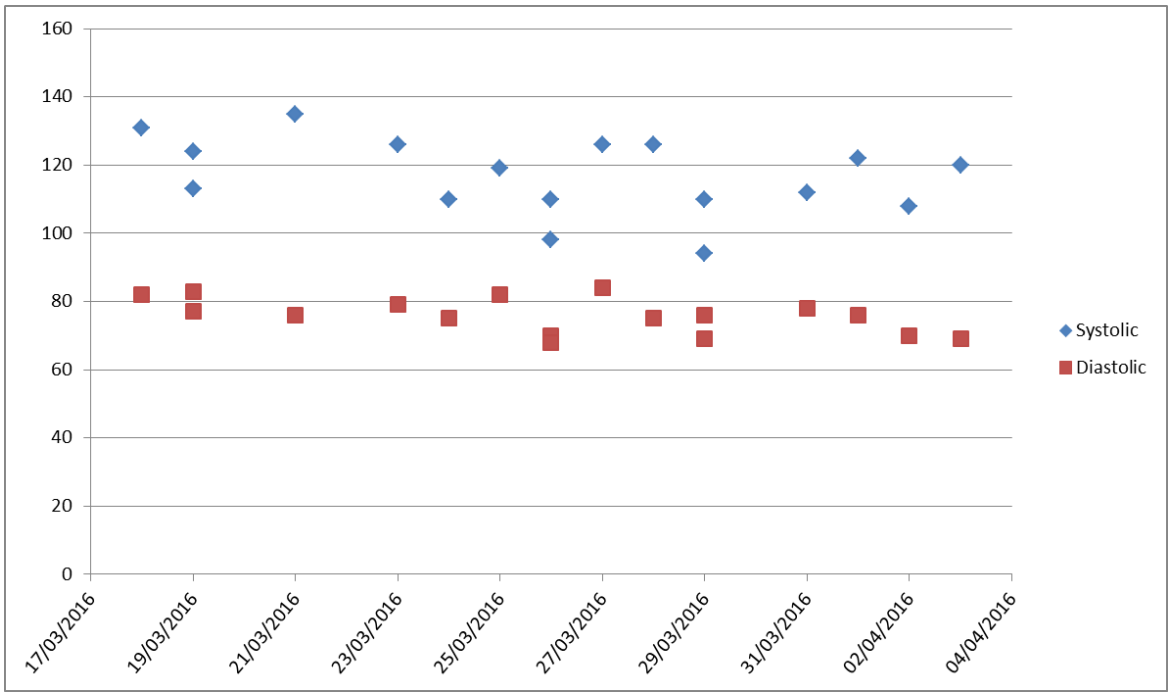

Figure 10. Readings of systolic and diastolic blood pressure (User 263)

3.6 Unstructured interview results

Users were asked to give their opinions during an interview in which a caregiver talked with them about their experiences with the prototype to get their opinions in these topics:

- Do they think using this prototype is useful for their health?
- Do they like it?

Regarding the users' opinions on the utility of ELF@Home for their health, there are two kinds of different opinions in the Spanish tests:

- The 3 users for the MANCOSI group agreed that they did not think that this prototype will help them improving their physical condition. They have stated that, as they go to gym classes specific for older people, they do more difficult exercises during those classes. And they prefer to go to those activities because they meet there with their friends.
- On the contrary, the OVIDA group of uses did not think that the exercises were too easy, they thought that the exercises were OK. So they agree that using this prototype is good for their health.

This difference in the opinions can be explained due to the difference in the user profiles. The first group are much more active physically than the second group.

These two groups of users have also different opinions on the health measurement procedure. Before starting the trials all the users said that they thought it was great that they would be able to get their own medical information every day. But after interacting with the prototype for some time some of them changed their point of view:

- The MANCOSI group did not like to have to measure 3 times in each session the blood pressure and the heart rate (SGGPA has stated as a requirement for the prototype that the variables are collected before, after and one minute after doing the exercises). They thought it was too much and they thought that they spent a lot of time waiting for the measures, especially for the blood pressure (as the device needs some time until it produces a measure).
- The OVIDA group did not mind much about doing these measures 3 times each session. But this group had more problems than the MANCOSI group in relation to the issues with the communications and they stated that they did not like that sometimes it did not work as expected.

Finally, both groups of users stated that they liked to use the prototype. Nevertheless, the MANCOSI group stated that they would like it more if the exercises were different because they were too simple. The MANCOSI users were able to use the prototype on their own. But the OVIDA group needed the help of a caregiver at first and then as they used it more they used it mostly without indications but they insisted on having the caregiver in the room with them all the time because they felt more confident that way. We have to take into account that the Spanish users have no technological skills so they do not know what to do is something unexpected happens with the prototype.

4 Supplementary Trial Results (Sweden)

4.1 Users selected

In Sweden there were two user groups, in Skellefteå and Åsele Municipalities. Skellefteå is a large town on the North Swedish coast, while Åsele is a small town located about 180 km inland in rural Västerbotten.

4.1.1 Skellefteå

In Skellefteå we tried the prototype in two user homes, with one man aged 78 and one woman aged 81. The woman only tried it a couple of times because she was afraid of falling over during the balance exercises.

Id	M / F	Age	From	To
275	M	78	05/04/2016	27/05/2016
284	F	81	02/05/2016	27/05/2016

Table 3. Swedish users (Skellefteå)

4.1.2 In Åsele

Four seniors have used the prototype for different periods of time, explained in the table below Another user (user 290) only used it for a day because of an unfortunate accident (unrelated to the use of the ELF@Home equipment) resulting in her breaking an arm. All of these users live in their own house or apartment and they are quite active physically. During the Swedish summer vacation month of July many of our Swedish elders have extended visits to their homes from younger family members. This has led to a reluctance to use the equipment during these times.

Id	M / F	Age	From	To
283	F	73	29/04/2016	01/07/2016
276	F	70	08/04/2016	28/04/2016
286	F	77	27/05/2016	19/06/2016
289	F	85	03/06/2016	14/06/2016
290	F	74	04/06/2016	04/06/2016

Table 4. Swedish users (Åsele)

4.2 Exercise frequency and scores

Figure 11 below, shows the total number of times each exercise was carried out, and Figure 12 the average performance scores across all Swedish users. Note that the score 100 indicates an exercise for which it is not possible to give a specific score. Tables for individual users are given in Annex A.

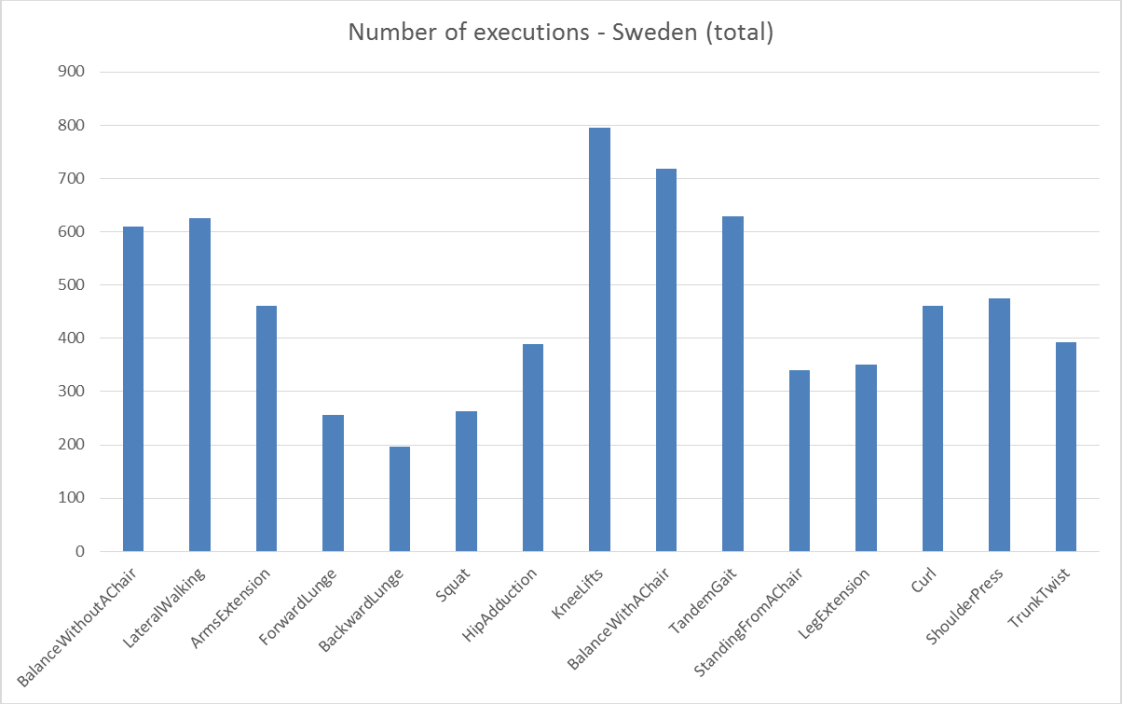

Figure 11. Number of exercises carried out (all Swedish users)

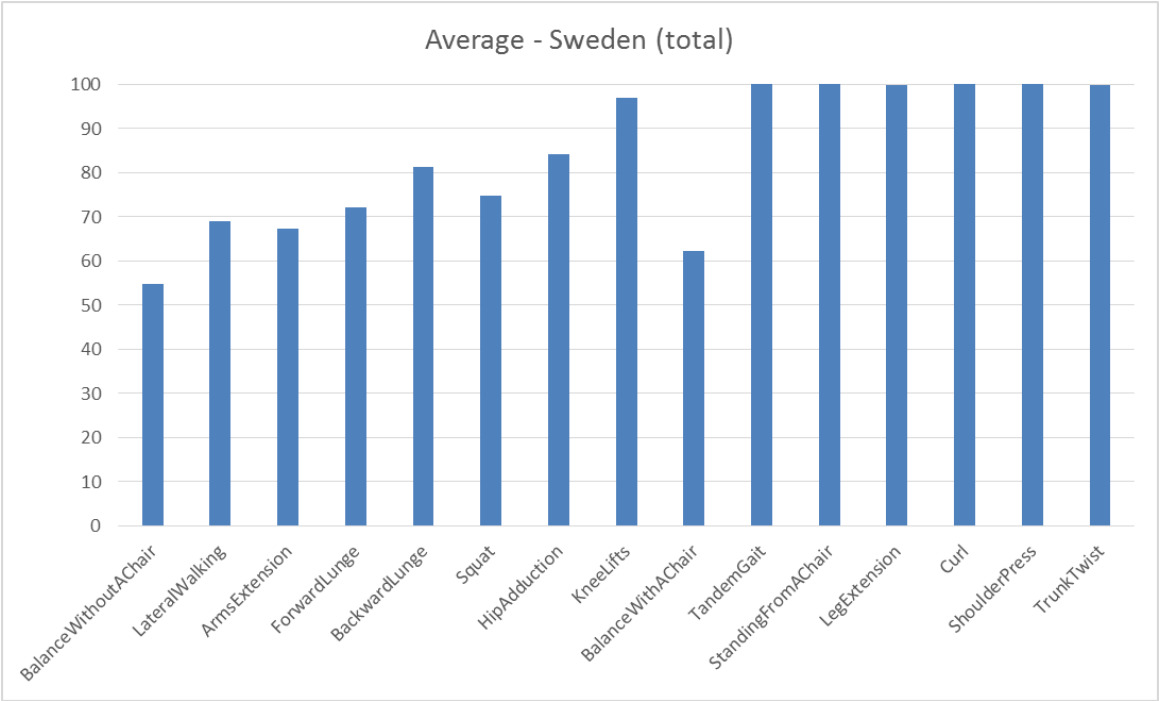

Figure 12. Average scores on the different exercises (all Swedish users)

4.3 Navigation mode (gestures, voice)

Gesture-based navigation was quite well liked and worked reasonably well, although users sometimes had problems with holding their hand in a fixed place for long enough to make their chosen selection.

Users appreciated the speech interaction, and most of the time it worked better than the hand gesture.

4.4 Problems reported

The users in Skellefteå did not like to use the prototype while the users in Åsele liked it and gave a lot of useful comments.

The biggest problem for the users is to locate where their hand is and to control the buttons with the hand. To start with it is hard to find the hand, it seems like the user had to raise the hand very high in order for it to show on the screen. Furthermore it seems like the hand moves by itself and it is very hard to keep it still and to the command.

In almost all the user homes that were tested the TV screen showed a cropped image of the interface/screen of the prototype.

The users noticed some wrong wording, for example when the button says “Try again” the voice command is “Continue”

In one of the balancing exercises, where the users walks four steps along a line, the system was found to mistakenly also count the steps when they go back to the starting point.

4.5 Health Status

Health status was measured by the users themselves, and recorded automatically by the system, as shown in the examples below. Data for individual users are given in Annex B.

4.5.1 Heart rate data, before and after exercise

The heart rate after doing the exercises is expected to be higher than the heart rate taken on the same day before going the exercises. Figure 13 below provides an example of heart rates of a selected individual user, taken before and after exercise.

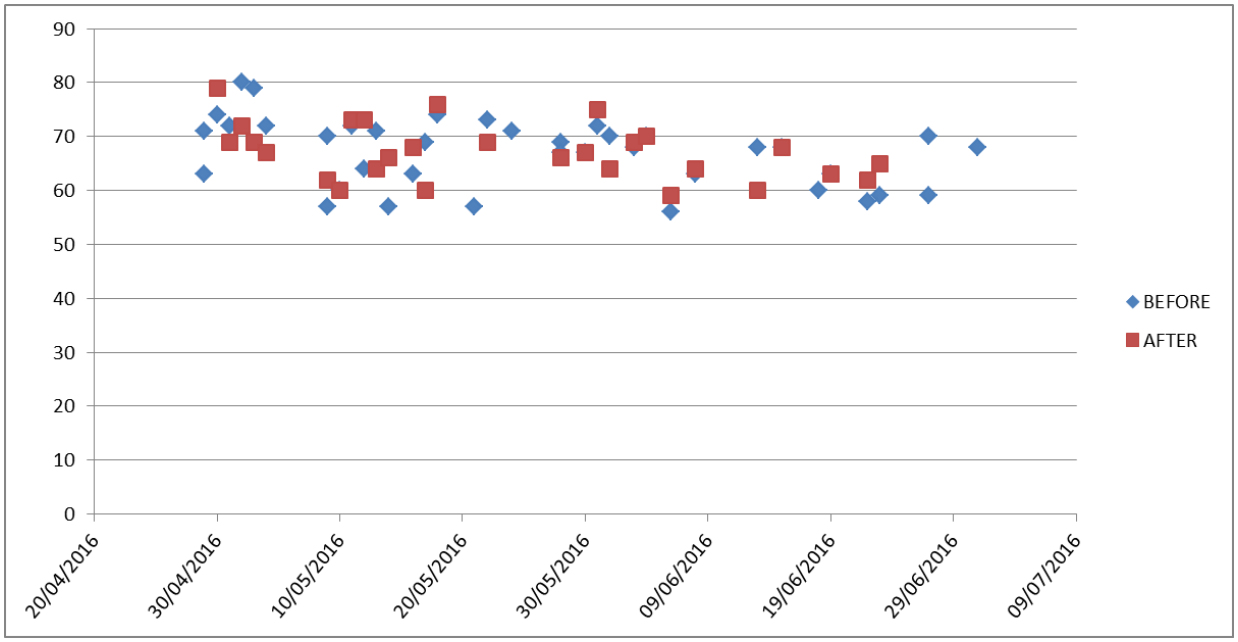

Figure 13. Heart rates taken before and after exercise (user 283)

4.5.2 Oxygen saturation

Figure 14 shows an example of readings taken of oxygen saturation from one user. In this case, the values do not change much and we show only the before readings in the figure.

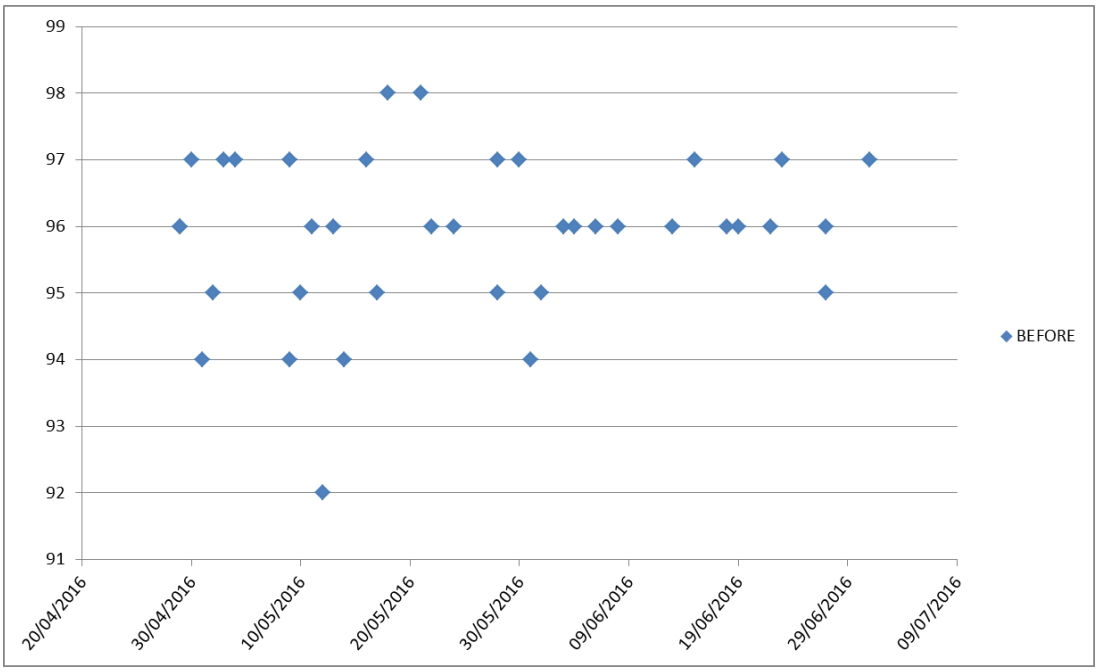

Figure 14. Example oxygen saturation readings (user 283)

4.5.3 Blood pressure

Figure 15 shows an example of blood pressure readings taken over a period of time using the prototype.

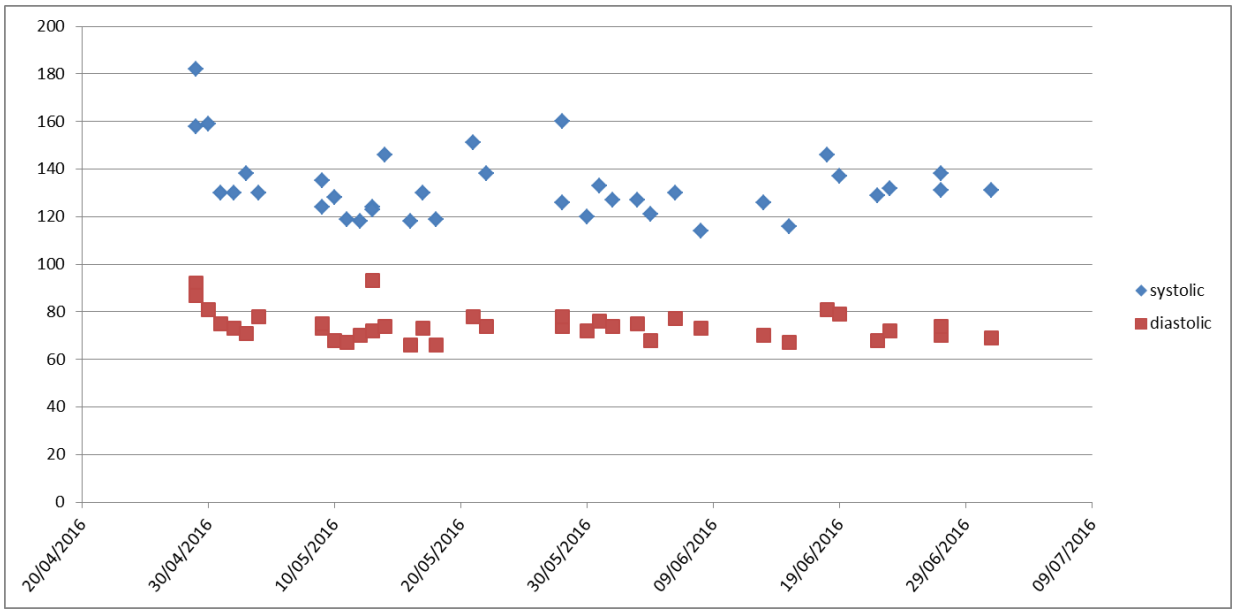

Figure 15. Readings of systolic and diastolic blood pressure (user 283)

4.6 Unstructured interview results

The users in Åsele like the prototype and think it is very useful and even necessary for senior citizens. When using it regularly it creates a demand that is very good. The outside exercises encourage the seniors to go out and then they meet other people and get more social interaction.

They do like to do the outdoor exercises and to use the bracelet and the waistband. They would like to be able to see the results from their outdoor activity, but so far it has not been technically possible to collect this data.

However, they did have some other negative views.

The 60 seconds pause between doing the same exercise was found to be too long. The seniors do not understand why they have to wait, since it is not very strenuous exercises. They also wonder why it is only between repetitions of the same exercises and not between different exercises. In sum they think the pause should be skipped.

Furthermore they think that the warming up exercises in the beginning are not necessary because they are similar to some of the actual exercises and they do not think it is necessary to warm up before the exercises that are included.

The stretching exercises at the end on the other hand are very good and they want to keep that since that feels good after doing the exercises.

The users want to be able to see their values and their progress, but also asked if it is necessary to take the measurements every day and three times during the indoor exercise. Is it not enough to take it one to two times a week if the measurements are normal and stable?

It would also be an advantage if it were possible to remove the demo videos when they know the exercises but have the chance to look at them if necessary.

5 Conclusions

The Swedish users believe that the ELF@Home system is necessary for seniors and that it would be a good aid in a senior's everyday life. However, in order for it to actually be a part of their everyday life the system has to have contact with a medical team that verify and adjust it to the specific user and who has responsibility for the user's health. The users have many times stressed the need for a medical team that can check the health status and to see that the exercises are custom made correctly for each individual user.

One drawback of the current prototype is that the users think it takes too long to do the indoor exercises. One way of overcoming this would be to remove the pauses and the warming up exercise. It would also save time if they did not have to do the measurements three times every day if the values are stable and normal.

Our users liked to do the outdoor exercises and to use the bracelet and the waistband. They would like to be able to see the results from their indoor and outdoor activities so that they can see their progress and are more motivated to continue using the system.

In Spain, the two user groups had different opinions: one Spanish group thought that the exercises were too easy and that the health measurements were too frequent, whereas the other Spanish group thought the exercises were correct for them and they liked to have the health measures.

References

[1] http://www.elfathome.eu

[2] Mahoney F. I & Barthel D. (1965) Functional evaluation: the Barthel Index. Md State Med J 14:56–61. .

[3] Guralnik J.M., Simonsick E.M., Ferrucci L, Glynn R.J., Berkman L.F., Blazer D.G. (1994). A short physical performance battery assessing lower extremity function: association with self-reported disability and prediction of mortality and nursing home admission. J Gerontol. 1994; 49(2): M85-94

Annex A Exercise performance data

A.1 Spanish Users

A.1.1 Schedules

In the following tables a summary of the different schedules that were generated by the EUPE for all the users were are shown:

Schedule ID	Start date	End date	Exercise Number	Exercise Name	Number of series	Number of repetitions
809	18/03/2016	26/03/2016	1	Squat	2	8
809	18/03/2016	26/03/2016	2	HipAdduction	2	8
809	18/03/2016	26/03/2016	3	StandingFromAChair	2	8
809	18/03/2016	26/03/2016	4	BalanceWithAChair	2	8
809	18/03/2016	26/03/2016	5	TandemGait	2	8
809	18/03/2016	26/03/2016	6	LateralWalking	2	8
850	26/03/2016	02/04/2016	1	ArmsExtension	2	8
850	26/03/2016	02/04/2016	2	BackwardLunge	2	8
850	26/03/2016	02/04/2016	3	LegExtension	2	8
850	26/03/2016	02/04/2016	4	KneeLifts	2	8
850	26/03/2016	02/04/2016	5	BalanceWithoutAChair	2	8
850	26/03/2016	02/04/2016	6	BalanceWithAChair	2	8
916	02/04/2016	11/04/2016	1	Curl	2	8
916	02/04/2016	11/04/2016	2	TrunkTwist	2	8
916	02/04/2016	11/04/2016	3	ShoulderPress	2	8
916	02/04/2016	11/04/2016	4	BalanceWithAChair	2	8
916	02/04/2016	11/04/2016	5	TandemGait	2	8
916	02/04/2016	11/04/2016	6	KneeLifts	2	8

Table 5. Indoor exercises schedule for User 263

Schedule ID	Start date	End date	Exercise Number	Exercise Name	Number of series	Number of repetitions
1137	22/04/2016	29/04/2016	1	HipAdduction	2	8
1137	22/04/2016	29/04/2016	2	LateralWalking	2	8
1137	22/04/2016	29/04/2016	3	LegExtension	2	8
1137	22/04/2016	29/04/2016	4	BalanceWithAChair	2	8

1137	22/04/2016	29/04/2016	5	BalanceWithoutAChair	2	8
1137	22/04/2016	29/04/2016	6	BackwardLunge	2	8
1210	29/04/2016	06/05/2016	1	ForwardLunge	2	8
1210	29/04/2016	06/05/2016	2	Squat	2	8
1210	29/04/2016	06/05/2016	3	ShoulderPress	2	8
1210	29/04/2016	06/05/2016	4	LateralWalking	2	8
1210	29/04/2016	06/05/2016	5	BalanceWithAChair	2	8
1210	29/04/2016	06/05/2016	6	KneeLifts	2	8
1318	06/05/2016	13/05/2016	1	Curl	2	8
1318	06/05/2016	13/05/2016	2	HipAdduction	2	8
1318	06/05/2016	13/05/2016	3	LegExtension	2	8
1318	06/05/2016	13/05/2016	4	KneeLifts	2	8
1318	06/05/2016	13/05/2016	5	BalanceWithAChair	2	8
1318	06/05/2016	13/05/2016	6	LateralWalking	2	8

Table 6. Indoor exercises schedule for User 280

Schedule ID	Start date	End date	Exercise Number	Exercise Name	Number of series	Number of repetitions
1167	25/04/2016	02/05/2016	1	BackwardLunge	2	8
1167	25/04/2016	02/05/2016	2	ArmsExtension	2	8
1167	25/04/2016	02/05/2016	3	LateralWalking	2	8
1167	25/04/2016	02/05/2016	4	ShoulderPress	2	8
1167	25/04/2016	02/05/2016	5	BalanceWithoutAChair	2	8
1167	25/04/2016	02/05/2016	6	KneeLifts	2	8
1267	02/05/2016	09/05/2016	1	TrunkTwist	2	8
1267	02/05/2016	09/05/2016	2	HipAdduction	2	8
1267	02/05/2016	09/05/2016	3	LegExtension	2	8
1267	02/05/2016	09/05/2016	4	BalanceWithoutAChair	2	8
1267	02/05/2016	09/05/2016	5	BalanceWithAChair	2	8
1267	02/05/2016	09/05/2016	6	KneeLifts	2	8
1342	09/05/2016	16/05/2016	1	ShoulderPress	2	8
1342	09/05/2016	16/05/2016	2	Curl	2	8
1342	09/05/2016	16/05/2016	3	ForwardLunge	2	8
1342	09/05/2016	16/05/2016	4	KneeLifts	2	8

1342	09/05/2016	16/05/2016	5	LateralWalking	2	8
1342	09/05/2016	16/05/2016	6	BalanceWithAChair	2	8
1761	06/06/2016	13/06/2016	1	Curl	2	8
1761	06/06/2016	13/06/2016	2	BackwardLunge	2	8
1761	06/06/2016	13/06/2016	3	ArmsExtension	2	8
1761	06/06/2016	13/06/2016	4	LateralWalking	2	8
1761	06/06/2016	13/06/2016	5	BalanceWithoutAChair	2	8
1761	06/06/2016	13/06/2016	6	BalanceWithAChair	2	8
1847	13/06/2016	20/06/2016	1	LegExtension	2	8
1847	13/06/2016	20/06/2016	2	HipAdduction	2	8
1847	13/06/2016	20/06/2016	3	TrunkTwist	2	8
1847	13/06/2016	20/06/2016	4	LateralWalking	2	8
1847	13/06/2016	20/06/2016	5	KneeLifts	2	8
1847	13/06/2016	20/06/2016	6	BalanceWithAChair	2	8

Table 7. Indoor exercises schedule for User 282

A.1.2 Performance

Exercise Name	263	264	265	270	271	272	273	274	279	280	282	TOTAL
BalanceWithoutAChair	46	28	4	8	64	16	96	48	32	16	80	**438**
LateralWalking	109	30	0	16	32	16	33	48	64	32	112	**492**
ArmsExtension	120	32	0	32	32	0	49	32	32	0	64	**393**
ForwardLunge	0	0	0	0	16	16	34	0	32	16	16	**130**
BackwardLunge	90	0	15	0	0	16	8	0	80	16	32	**257**
Squat	156	32	32	0	32	0	48	32	32	16	0	**380**
HipAdduction	135	31	11	32	32	16	32	32	32	19	48	**420**
KneeLifts	76	116	8	32	64	32	96	48	144	16	96	**728**
BalanceWithAChair	180	77	10	40	64	16	112	80	144	32	96	**851**
TandemGait	115	89	4	24	48	16	48	56	128	0	0	**528**
StandingFromAChair	80	8	5	0	48	0	65	25	0	0	0	**231**
LegExtension	78	90	3	5	48	32	64	40	112	16	48	**536**
Curl	14	105	8	16	16	0	16	16	64	0	48	**303**
ShoulderPress	16	123	0	16	16	16	48	32	80	16	48	**411**
TrunkTwist	1	0	0	16	32	0	22	2	64	0	48	**185**
	1216	**761**	**100**	**237**	**544**	**192**	**771**	**491**	**1040**	**195**	**736**	**6283**

Table 8. Number of exercises carried out (all Spanish users)

Exercise Name	263	264	265	270	271	272	273	274	279	280	282	AVERAGE
BalanceWithoutAChair	51	56	61	53	53	50	51	54	51	55	53	**53**
LateralWalking	55	69	0	73	68	68	58	70	66	67	84	**68**
ArmsExtension	91	72	0	56	65	0	70	0	91	0	75	**72**
ForwardLunge	0	0	0	0	64	72	75	0	65	69	84	**71**
BackwardLunge	58	0	78	0	0	58	100	0	61	57	58	**62**
Squat	85	70	91	0	84	0	69	71	62	65	0	**78**
HipAdduction	74	85	78	84	76	74	81	79	76	85	91	**79**
KneeLifts	94	92	100	94	96	97	83	88	87	88	99	**91**
BalanceWithAChair	53	58	67	60	56	64	58	55	53	56	58	**56**
TandemGait	100	100	100	100	100	100	100	100	100	0	0	**100**
StandingFromAChair	100	100	100	0	100	0	100	100	0	0	0	**100**
LegExtension	100	100	100	100	100	100	100	100	100	100	100	**100**
Curl	100	100	100	100	100	0	100	100	100	0	100	**100**
ShoulderPress	100	100	0	100	100	100	100	100	100	100	100	**100**
TrunkTwist	100	0	0	100	100	0	100	100	100	0	100	**100**

Table 8. Average scores on the different exercises (all Spanish users)

A.2 Swedish Users

A.2.1 Schedules

Schedule ID	Start date	End date	Exercise Number	Exercise Name	Number of series	Number of repetitions
933	05/04/2016	12/04/2016	1	KneeLifts	2	8
933	05/04/2016	12/04/2016	2	ForwardLunge	2	8
933	05/04/2016	12/04/2016	3	LateralWalking	2	8
933	05/04/2016	12/04/2016	4	Curl	2	8
933	05/04/2016	12/04/2016	5	TandemGait	2	8
933	05/04/2016	12/04/2016	6	TrunkTwist	2	8
1007	12/04/2016	19/04/2016	1	LegExtension	2	8
1007	12/04/2016	19/04/2016	2	Squat	2	8
1007	12/04/2016	19/04/2016	3	StandingFromAChair	2	8
1007	12/04/2016	19/04/2016	4	TandemGait	2	8
1007	12/04/2016	19/04/2016	5	BalanceWithAChair	2	8
1007	12/04/2016	19/04/2016	6	KneeLifts	2	8
1060	19/04/2016	26/04/2016	1	ShoulderPress	2	8
1060	19/04/2016	26/04/2016	2	HipAdduction	2	8
1060	19/04/2016	26/04/2016	3	BackwardLunge	2	8
1060	19/04/2016	26/04/2016	4	BalanceWithoutAChair	2	8
1060	19/04/2016	26/04/2016	5	KneeLifts	2	8
1060	19/04/2016	26/04/2016	6	BalanceWithAChair	2	8

Table 9. Indoor exercises schedule for User 275

Schedule ID	Start date	End date	Exercise Number	Exercise Name	Number of series	Number of repetitions
970	08/04/2016	15/04/2016	1	HipAdduction	2	8
970	08/04/2016	15/04/2016	2	ArmsExtension	2	8
970	08/04/2016	15/04/2016	3	TandemGait	2	8
970	08/04/2016	15/04/2016	4	Squat	2	8
970	08/04/2016	15/04/2016	5	BalanceWithAChair	2	8
970	08/04/2016	15/04/2016	6	LateralWalking	2	8
1045	15/04/2016	22/04/2016	1	LegExtension	2	8
1045	15/04/2016	22/04/2016	2	Curl	2	8
1045	15/04/2016	22/04/2016	3	StandingFromAChair	2	8
1045	15/04/2016	22/04/2016	4	BalanceWithAChair	2	8
1045	15/04/2016	22/04/2016	5	KneeLifts	2	8
1045	15/04/2016	22/04/2016	6	BalanceWithoutAChair	2	8
1122	22/04/2016	29/04/2016	1	TrunkTwist	2	8
1122	22/04/2016	29/04/2016	2	ArmsExtension	2	8
1122	22/04/2016	29/04/2016	3	ShoulderPress	2	8
1122	22/04/2016	29/04/2016	4	BalanceWithoutAChair	2	8
1122	22/04/2016	29/04/2016	5	LateralWalking	2	8
1122	22/04/2016	29/04/2016	6	TandemGait	2	8

Table 10. Indoor exercises schedule for User 276

Schedule ID	Start date	End date	Exercise Number	Exercise Name	Number of series	Number of repetitions
1215	29/04/2016	06/05/2016	1	BalanceWithoutAChair	2	8
1215	29/04/2016	06/05/2016	2	HipAdduction	2	8
1215	29/04/2016	06/05/2016	3	ShoulderPress	2	8
1215	29/04/2016	06/05/2016	4	LateralWalking	2	8
1215	29/04/2016	06/05/2016	5	BackwardLunge	2	8
1215	29/04/2016	06/05/2016	6	BalanceWithAChair	2	8
1323	29/04/2016	06/05/2016	1	ArmsExtension	2	8
1323	06/05/2016	13/05/2016	2	LegExtension	2	8
1323	06/05/2016	13/05/2016	3	StandingFromAChair	2	8

1323	06/05/2016	13/05/2016	4	KneeLifts	2	8
1323	06/05/2016	13/05/2016	5	BalanceWithAChair	2	8
1323	06/05/2016	13/05/2016	6	TandemGait	2	8
1404	13/05/2016	20/05/2016	1	TrunkTwist	2	8
1404	13/05/2016	20/05/2016	2	Squat	2	8
1404	13/05/2016	20/05/2016	3	Curl	2	8
1404	13/05/2016	20/05/2016	4	LateralWalking	2	8
1404	13/05/2016	20/05/2016	5	BalanceWithAChair	2	8
1404	13/05/2016	20/05/2016	6	KneeLifts	2	8
1499	13/05/2016	20/05/2016	1	HipAdduction	2	8
1499	20/05/2016	27/05/2016	2	ArmsExtension	2	8
1499	20/05/2016	27/05/2016	3	ShoulderPress	2	8
1499	20/05/2016	27/05/2016	4	BalanceWithoutAChair	2	8
1499	20/05/2016	27/05/2016	5	KneeLifts	2	8
1499	20/05/2016	27/05/2016	6	TandemGait	2	8
1604	27/05/2016	03/06/2016	1	ForwardLunge	2	8
1604	27/05/2016	03/06/2016	2	LegExtension	2	8
1604	27/05/2016	03/06/2016	3	StandingFromAChair	2	8
1604	27/05/2016	03/06/2016	4	BalanceWithAChair	2	8
1604	27/05/2016	03/06/2016	5	TandemGait	2	8
1604	27/05/2016	03/06/2016	6	KneeLifts	2	8
1700	03/06/2016	10/06/2016	1	Curl	2	8
1700	03/06/2016	10/06/2016	2	BackwardLunge	2	8
1700	03/06/2016	10/06/2016	3	TrunkTwist	2	8
1700	03/06/2016	10/06/2016	4	LateralWalking	2	8
1700	03/06/2016	10/06/2016	5	KneeLifts	2	8
1700	03/06/2016	10/06/2016	6	BalanceWithAChair	2	8
1825	10/06/2016	17/06/2016	1	HipAdduction	2	8
1825	10/06/2016	17/06/2016	2	ArmsExtension	2	8
1825	10/06/2016	17/06/2016	3	ShoulderPress	2	8
1825	10/06/2016	17/06/2016	4	KneeLifts	2	8
1825	10/06/2016	17/06/2016	5	BalanceWithoutAChair	2	8
1825	10/06/2016	17/06/2016	6	TandemGait	2	8
1941	17/06/2016	24/06/2016	1	StandingFromAChair	2	8

1941	17/06/2016	24/06/2016	2	Squat	2	8
1941	17/06/2016	24/06/2016	3	LegExtension	2	8
1941	17/06/2016	24/06/2016	4	KneeLifts	2	8
1941	17/06/2016	24/06/2016	5	TandemGait	2	8
1941	17/06/2016	24/06/2016	6	BalanceWithAChair	2	8
2027	24/06/2016	01/07/2016	1	BackwardLunge	2	8
2027	24/06/2016	01/07/2016	2	TrunkTwist	2	8
2027	24/06/2016	01/07/2016	3	Curl	2	8
2027	24/06/2016	01/07/2016	4	KneeLifts	2	8
2027	24/06/2016	01/07/2016	5	BalanceWithoutAChair	2	8
2027	24/06/2016	01/07/2016	6	LateralWalking	2	8
2155	01/07/2016	08/07/2016	1	ShoulderPress	2	8
2155	01/07/2016	08/07/2016	2	ArmsExtension	2	8
2155	01/07/2016	08/07/2016	3	HipAdduction	2	8
2155	01/07/2016	08/07/2016	4	BalanceWithAChair	2	8
2155	01/07/2016	08/07/2016	5	KneeLifts	2	8
2155	01/07/2016	08/07/2016	6	TandemGait	2	8

Table 11. Indoor exercises schedule for User 283

A.2.2 Performance

Exercise Name	275	276	283	284	286	289	290	TOTAL
BalanceWithoutAChair	0	220	182	16	176	0	16	**610**
LateralWalking	80	184	224	0	128	9	0	**625**
ArmsExtension	0	208	173	0	80	0	0	**461**
ForwardLunge	80	0	64	0	96	0	16	**256**
BackwardLunge	5	0	160	0	32	0	0	**197**
Squat	23	80	128	0	16	16	0	**263**
HipAdduction	16	96	182	16	80	0	0	**390**
KneeLifts	80	110	422	16	152	0	16	**796**
BalanceWithAChair	0	192	415	0	112	0	0	**719**
TandemGait	80	193	242	0	96	2	16	**629**
StandingFromAChair	0	112	176	0	53	0	0	**341**
LegExtension	16	112	177	3	26	0	16	**350**
Curl	80	112	160	0	97	12	0	**461**
ShoulderPress	27	112	176	16	128	0	16	**475**
TrunkTwist	80	112	160	1	32	8	0	**393**
	567	**1843**	**3041**	**68**	**1304**	**47**	**96**	**6966**

Table 12. Number of exercises carried out (all Swedish users)

Exercise Name	275	276	283	284	286	289	290	AVERAGE
BalanceWithoutAChair	0	50	54	100	58	0	50	**55**
LateralWalking	62	57	86	0	62	53	0	**69**
ArmsExtension	0	53	72	0	93	0	0	**67**
ForwardLunge	67	0	83	0	66	0	86	**72**
BackwardLunge	99	0	82	0	74	0	0	**81**
Squat	68	62	87	0	58	63	0	**75**
HipAdduction	96	77	95	60	71	0	0	**84**
KneeLifts	92	93	100	59	98	0	99	**97**
BalanceWithAChair	0	54	65	0	68	0	0	**62**
TandemGait	100	100	100	0	100	100	100	**100**
StandingFromAChair	0	100	100	0	100	0	0	**100**
LegExtension	100	100	100	87	100	0	100	**100**
Curl	100	100	100	0	100	100	0	**100**
ShoulderPress	100	100	100	100	100	0	100	**100**
TrunkTwist	100	100	100	75	100	100	0	**100**

Table 13. Average scores on the different exercises (all Swedish users)

Annex B Health status data from individual users

B.1 Spanish Users

B.1.1 Heart rate data, before and after exercise

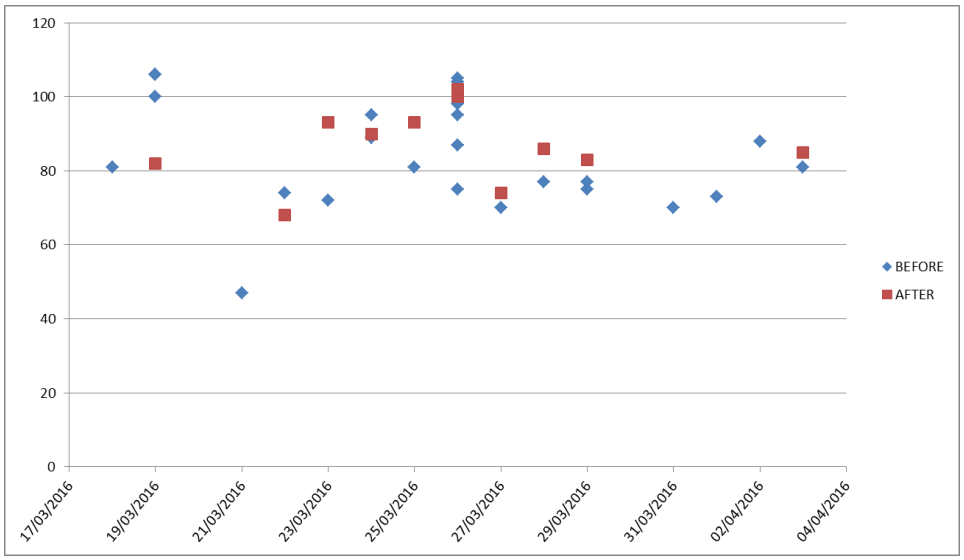

Figure 16. Heart rates taken before and after exercise (User 263)

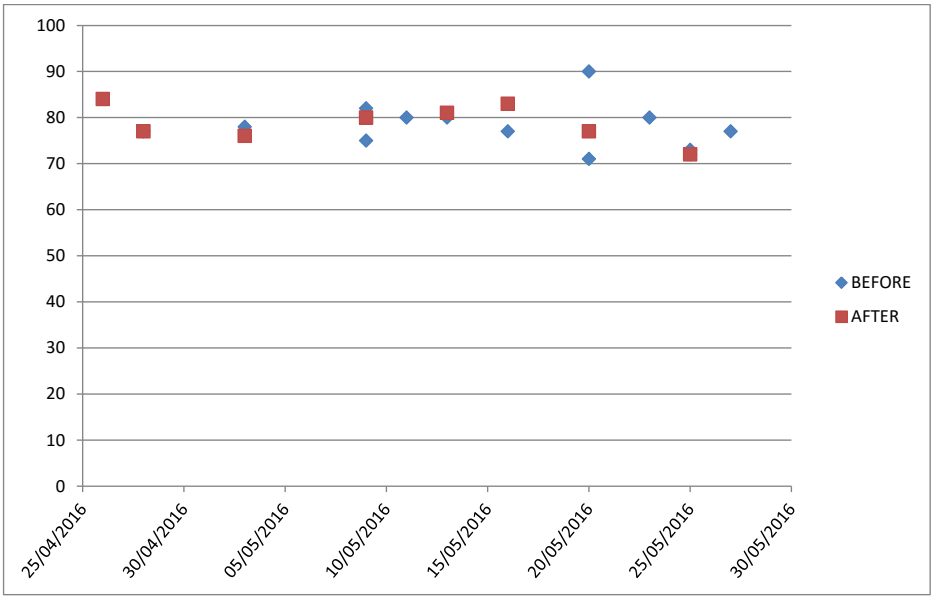

Figure 17. Heart rates taken before and after exercise (User 279)

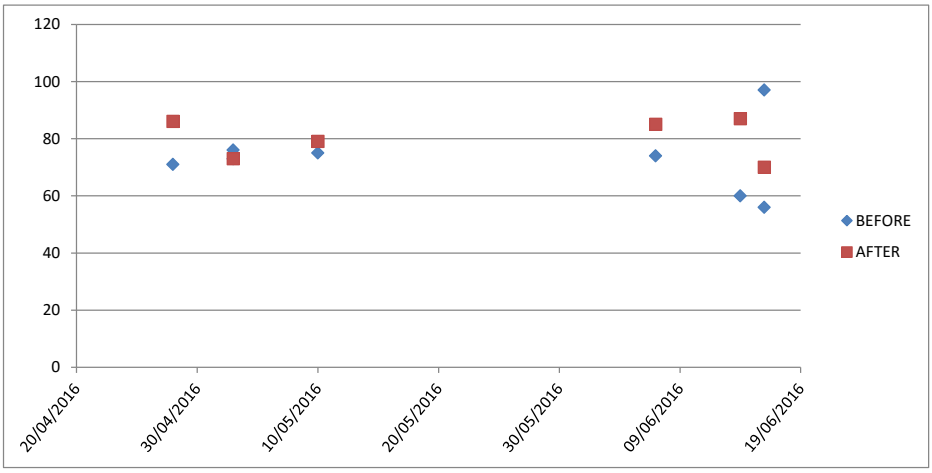

Figure 18. Heart rates taken before and after exercise (User 282)

B.1.2 Oxygen saturation

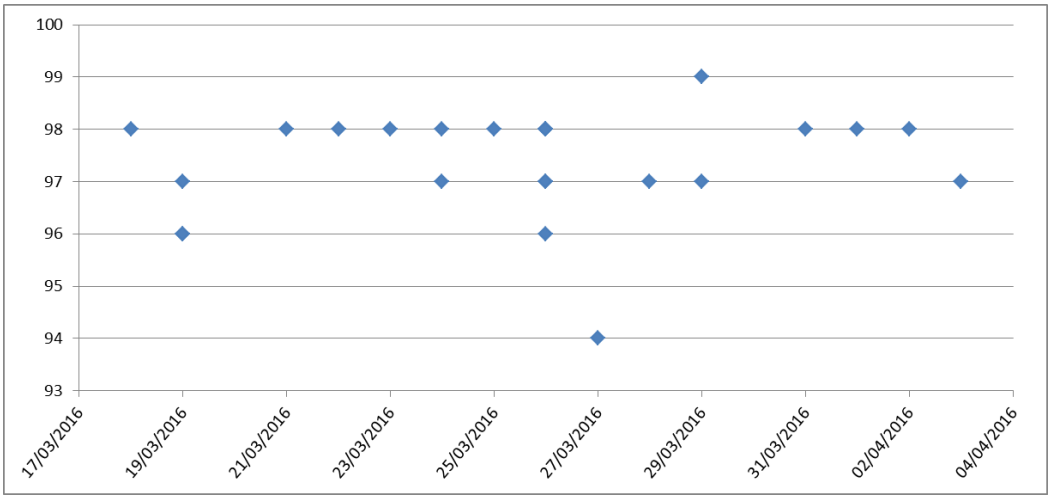

Figure 19. Example oxygen saturation readings (User 263)

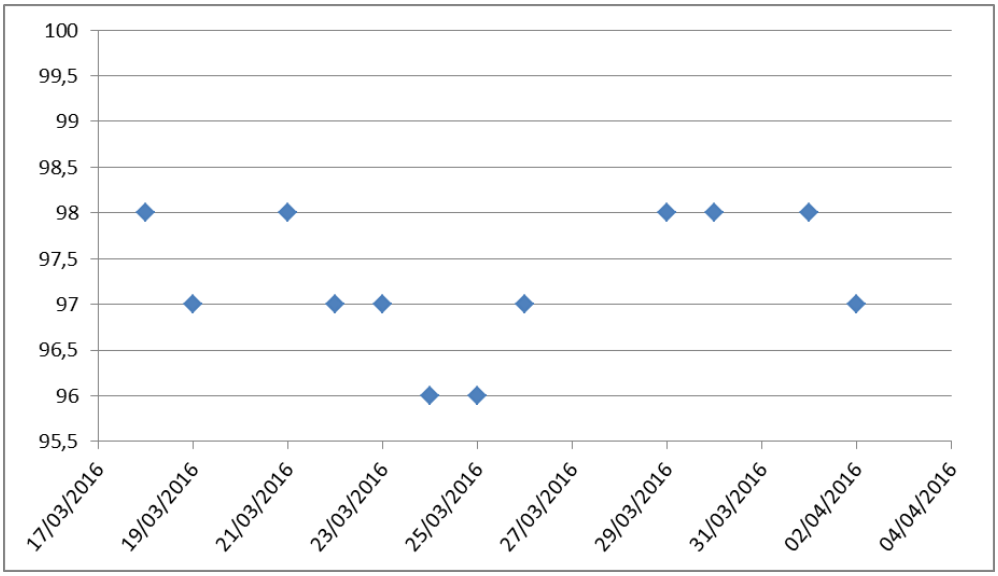

Figure 20. Example oxygen saturation readings (User 264)

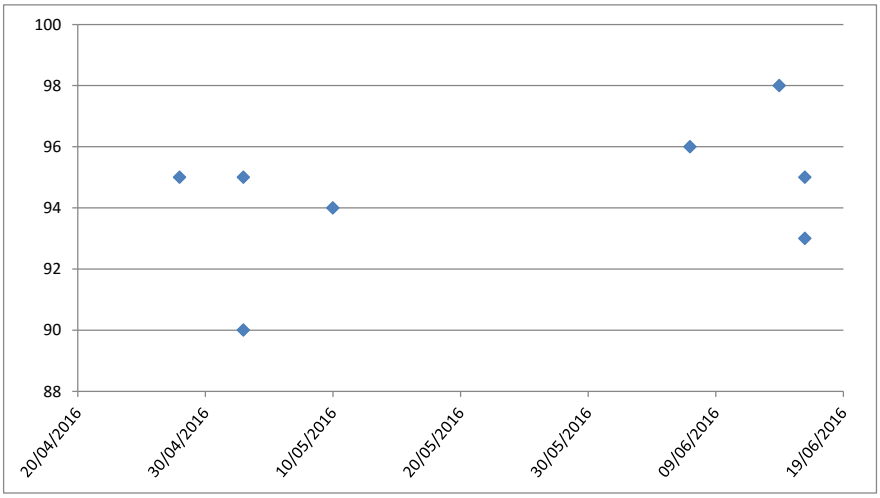

Figure 21. Example oxygen saturation readings (User 282)

B.1.3 Blood pressure

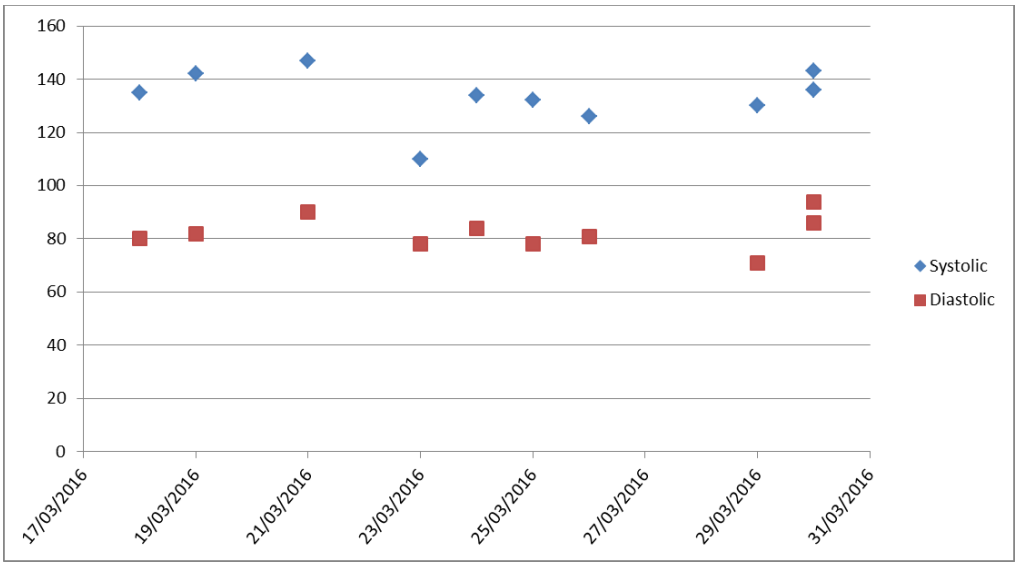

Figure 22. Readings of systolic and diastolic blood pressure (User 264)

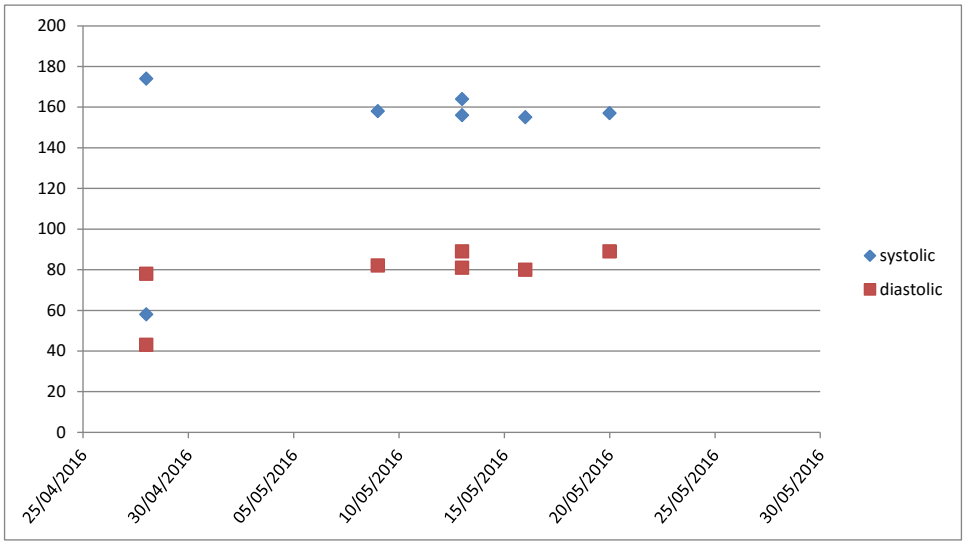

Figure 23. Readings of systolic and diastolic blood pressure (User 279)

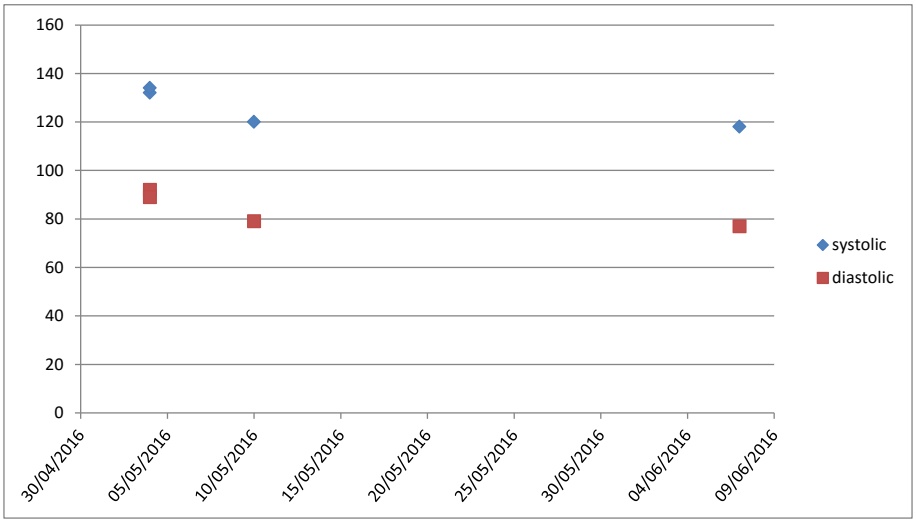

Figure 24. Readings of systolic and diastolic blood pressure (User 282)

B.2 Swedish Users

B.2.1 Heart rate data, before and after exercise

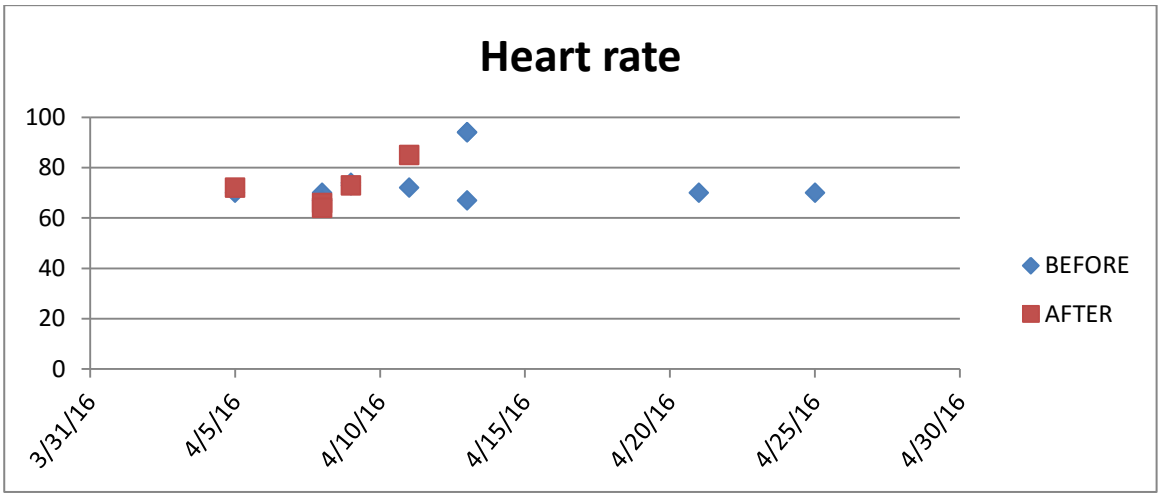

Figure 25. Heart rates taken before and after exercise (user 275)

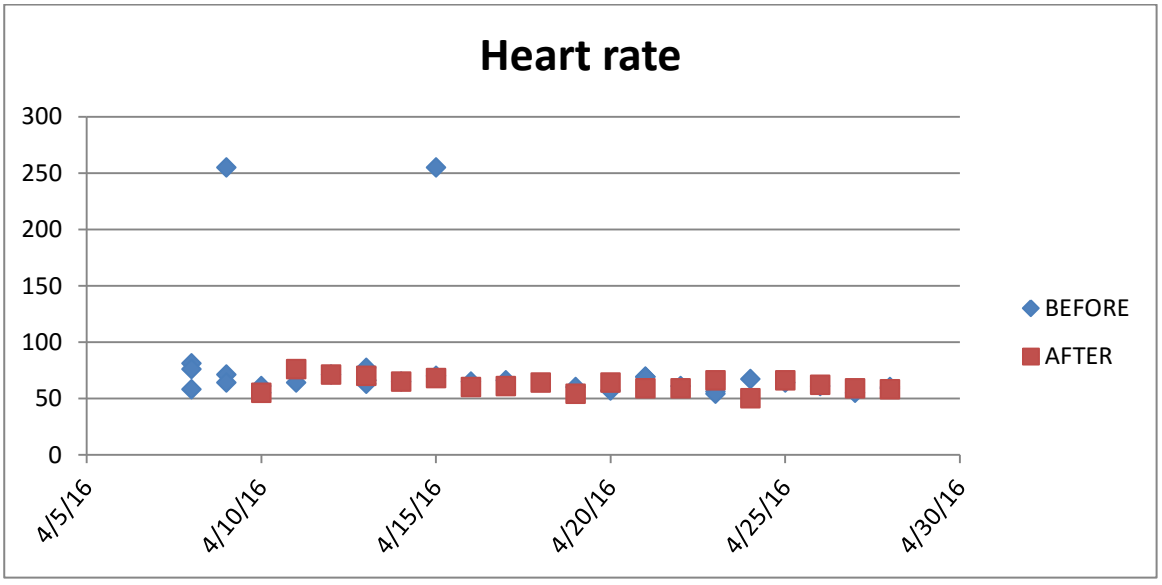

Figure 26. Heart rates taken before and after exercise (user 276)

B.2.2 Oxygen saturation

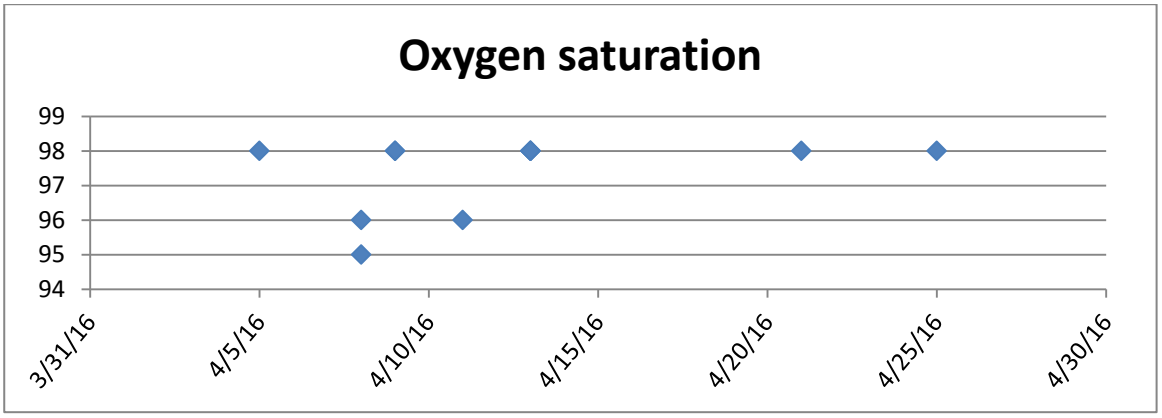

Figure 27. Oxygen saturation readings (user 275)

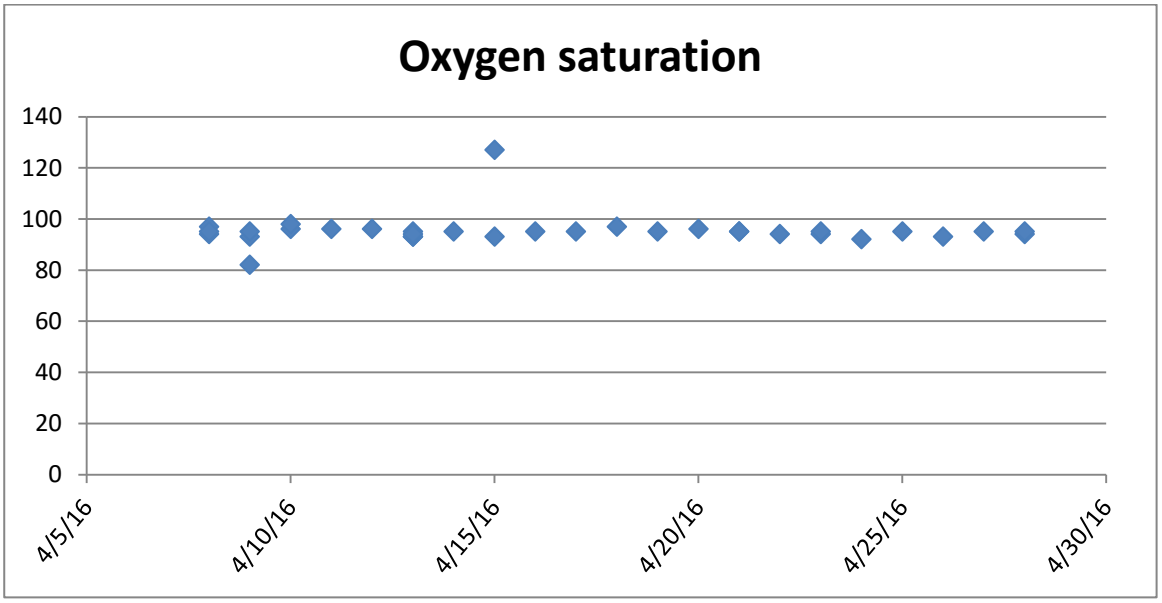

Figure 28. Oxygen saturation readings (user 276)

B.2.3 Blood pressure

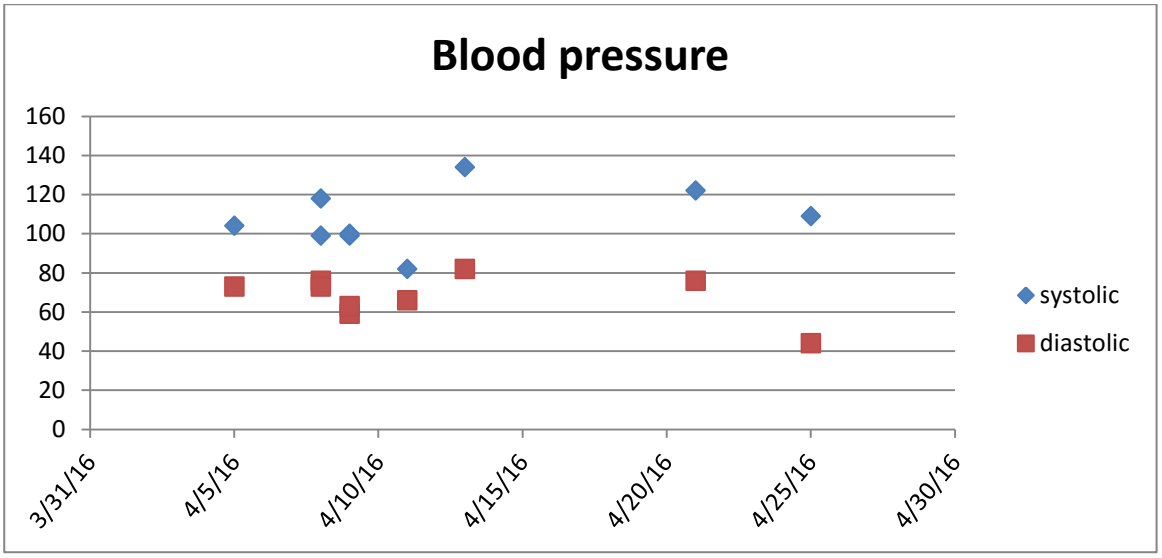

Figure 29. Readings of systolic and diastolic blood pressure (user 275)

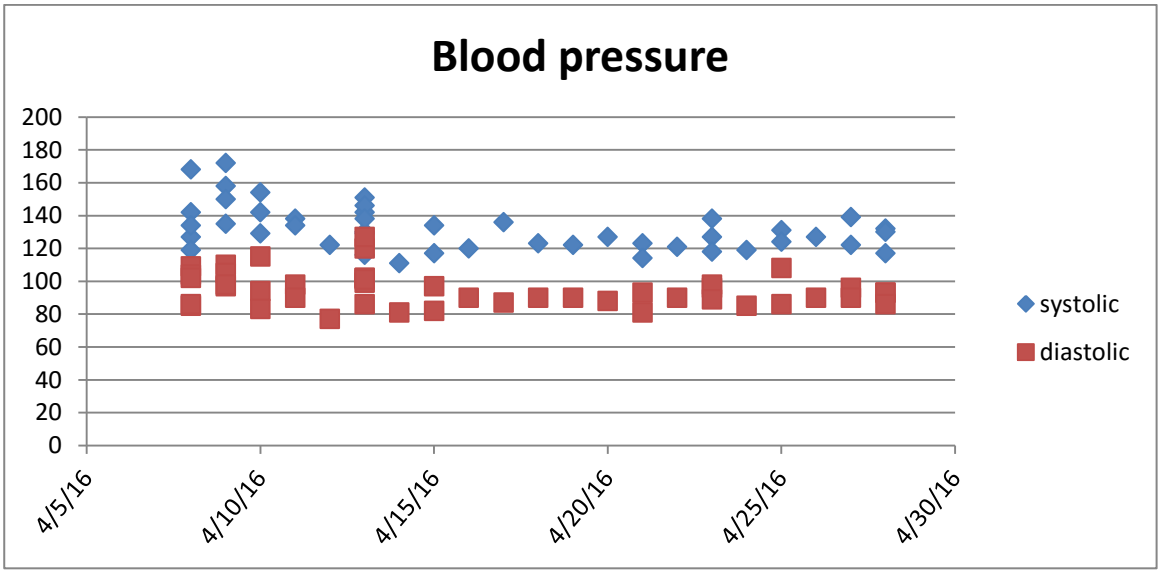

Figure 30. Readings of systolic and diastolic blood pressure (user 276)

Annex C Photos from the trials

In the following sections some photos are displayed to show the prototypes installed and the users interacting with ELF@Home.

C.1 Spanish Users

C.1.1 MANCOSI

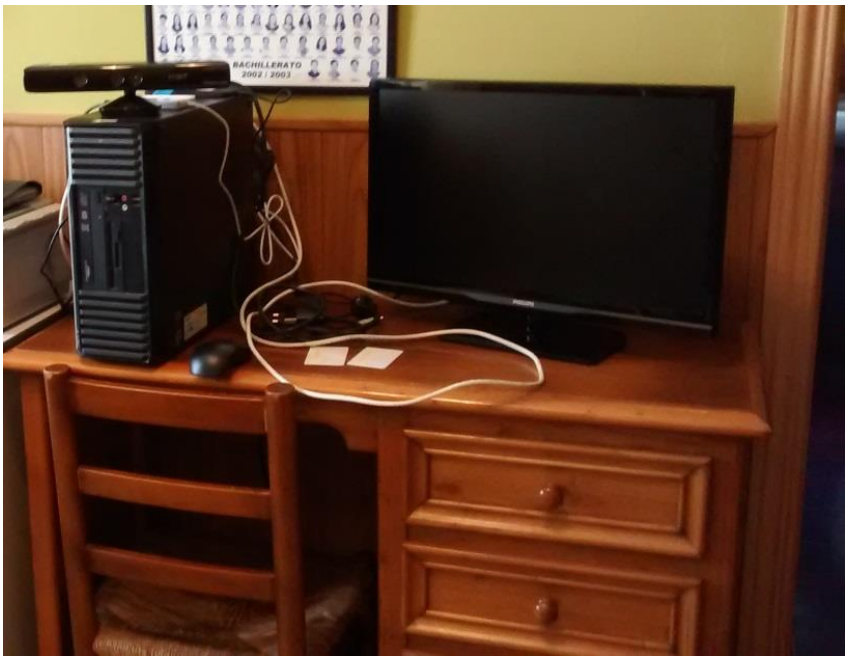

Figure 31. Prototype installed in a home (MANCOSI)

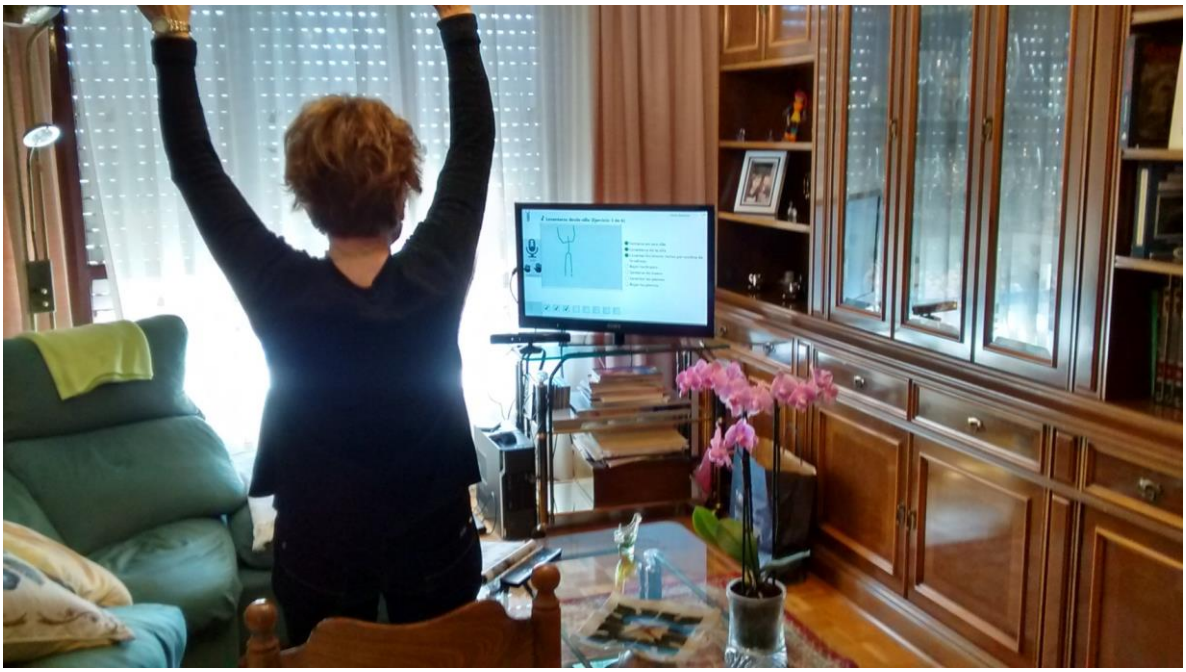

Figure 32. User interacting with ELF@Home (MANCOSI)

C.1.2 OVIDA

Figure 33. User interacting with ELF@Home (OVIDA)

Figure 34. User interacting with ELF@Home (OVIDA)

Figure 35. User interacting with ELF@Home (OVIDA)

C.2 Swedish Users

Figure 36. User interacting with ELF@Home (Åsele)

Figure 37. User Performing exercise (Åsele)

Figure 38. User taking blood pressure measurement (Åsele)

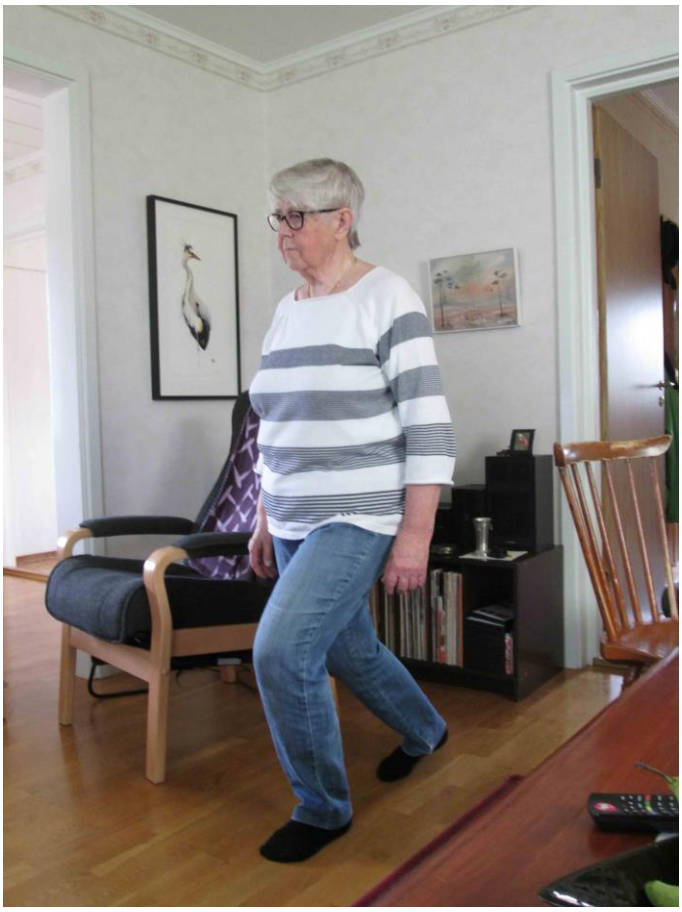

Figure 39. User Performing exercise (Åsele)

Figure 40. User Performing exercise (Åsele)