



## engAGE

Managing cognitivE decliNe throuGh theatre therapy, Artificial intelligence  
and social robots drivEn interventions

### D2.3 User experience design



<b>Deliverable Id:</b>	D2.3
<b>Deliverable Title:</b>	User experience design
<b>Related Work Package:</b>	WP2
<b>Related Task(s):</b>	T2.3
<b>Related Milestone:</b>	MS3
<b>Version:</b>	V2.0
<b>Status:</b>	Final version
<b>Dissemination Level:</b>	PU
<b>Deliverable Type:</b>	R
<b>Due date of deliverable:</b>	M14 (January 2023)
<b>Actual submission date:</b>	February 20, 2023
<b>Deliverable lead partner:</b>	HUG
<b>Main author(s):</b>	Gosetto, L. (HUG)
<b>Contributing authors:</b>	ALL
<b>Peer-reviewers:</b>	Amabili, G. (INRCA), Grimstad, T. (KRD)
<b>Keywords:</b>	Updated design, user experience, interfaces, screen mock-ups

*Project partially funded by AAL Joint programme and Unitatea Executiva pentru Finantarea Invatamantului Superior, a Cercetarii, Dezvoltarii si Inovarii (UEFISCDI) (RO), The Research Council of Norway (NO), Federal Department of Economic Affairs, Education and Research / State Secretariat for Education, Innosuisse (CH) and Italian Ministry of Health (IT) under the Consortium Agreement number **aal-2021-8-159-CP**.*

## Version history

Version	Authors	Date	Description
0.1	Villaverde, A. (HUG)	03.06.2022	First full draft
0.2	Boye, L.T. (TLU)	07.07.2022	Mobile application gateway
0.3	Villaverde, A. (HUG), Crettenand, J. (HUG)	07.07.2022	Adding of the interface's screens mock-ups
0.4	Grimstad, T. (KRD)	23.08.2022	Adding of MEMAS App mock-ups
0.5	Marin, A. (IRIS)		Adding of IRIS
0.6	Villaverde, A. (HUG)	31.08.2022	First Complete version
0.7	Grimstad, T. (KRD)	05.09.2022	Peer review
0.8	Amabili, G. (INRCA)	07.09.2022	Peer review
0.9	Anghel, I. (TUC) + Gosetto, L. (HUG)	07.09.2022	Peer review comments implementation
0.99	Cioara, T. (TUC)	08.09.2022	Quality check ready version
1.0	Anghel, I. (TUC)	12.09.2022	Final version
1.2	Gosetto, L. (HUG)	25.01.2023	Adding heuristic evaluation protocol
1.3	Boye, L.T. (TLU)	01.02.2023	New description of Dialogg interface
1.4	Marin, A. (IRIS)	10.02.2023	New Pepper interfaces added.
1.5	Amabili, G. (INRCA)	13.02.2023	Review and refinements;
1.5	Grimstad, T. (KRD)	16.02.2023	New description of Memas in section 3.3; Review.
1.6	Gosetto L. (HUG)	16.02.2023	Quality check ready version.
2.0	Anghel, I., Cioara, T. (TUC)	20.02.2023	Final version.

## Contents

Executive summary .....	5
1 Introduction .....	6
1.1 Intended Audience .....	6
1.2 Relations to other activities .....	6
1.3 Document overview .....	6
2 Requirements summary .....	7
3 Updated mock-ups and dashboards .....	9
3.1 Social Robot Coaching and Cognitive Stimulation .....	9
3.1.1 First interaction .....	9
3.1.2 ID logging / account .....	10
3.1.3 Profile – Dashboard score .....	11
3.1.4 Cognitive games’ menu .....	11
3.1.5 Settings .....	12
3.1.6 Playing games .....	13
3.2 Monitoring, Self-Reporting and Big Data Processing .....	15
3.2.1 Logging in .....	15
3.2.2 Gateway page .....	16
3.2.3 Profile & Settings .....	17
3.2.4 Fitbit activity tracker .....	17
3.3 Communication Platform and Intelligent Personalization .....	21
3.3.1 The web administration module .....	22
3.3.2 The client - tablet application .....	26
3.4 Types of Human-Machine Interactions .....	27
3.5 Types of support .....	29
3.5.1 Cognitive .....	29
3.5.2 Coaching .....	30
4 Heuristic Evaluation .....	31
4.1 Participants criteria .....	31
4.2 User Involvement .....	31
4.3 Channels of recruitment .....	31
4.4 Heuristic evaluation methodology .....	31
4.4.1 Evaluation grid .....	32
4.4.2 Bastien & Scapin’s heuristics .....	32

4.4.3	Nielsen’s heuristics.....	33
4.4.4	Nielsen’s Gravity scale .....	34
5	Conclusions .....	35

## List of acronyms

Acronym	Description
AAL	Ambient Assisted Living
TUC	Technical University of Cluj-Napoca
IRIS	IRIS robotics
TLU	Tellu AS
KRD	KARDE SA
HUG	University Hospitals of Geneva
SMCI	Seniors with mild cognitive impairment
INRCA	National Institute of Health and Science on Ageing
WP	Work package
MCI	Mild Cognitive Impairment
UX	User Experience
HCI	Human-computer Interaction

## Executive summary

The user experience design was one of the main activities from the first meetings and interviews held with the end-users. Through them, end-users from Switzerland, Italy and Norway have gathered needs, challenges, and expectations, which have been then transformed into technical requirements, mock-ups, and dashboards. The screens and interfaces provided as mock-ups in the first version of the current deliverable (D2.3v1) were created considering the end users requirements the engAGE platform services and components such as screens from Pepper robot tablet or Memas. Those mock-ups were the basis for our design reflections and the starting point for the end-users' evaluation.

Considering the received feedback the mock-ups have been improved and evolved for the current version of the deliverable (D2.3v2) aiming to provide a better design of the engAGE solution to end-users, who will, in the next steps, decide whether their needs have been understood and what changes still need to be done to tackle design issues.

Some of the mock-ups have been already implemented and transformed into graphical user interfaces customized to the elders' wishes and needs while considering the specific requirements of elders with MCI. Heuristic evaluations are underway and used to measure the end-user satisfaction and experience in using the engAGE services interfaces: 1 round of heuristic evaluations with at least one usability expert per end-user partner and 2-3 participants per user-profiles and per end-user partner for usability testing in the 1<sup>st</sup> version of the prototype lab testing trials.

## 1 Introduction

engAGE is a virtual assistant offering support to elderly population who is facing some cognitive issues. The aim of the project to combat and slow down cognitive decline progression, to enhance the intrinsic capacity of the users, and to support the wellbeing of older persons with mild cognitive impairment (MCI). The services that will be provided on the robot solution have already been sorted out by end-users and are, among other things, presented in this deliverable.

engAGE project adopts a user-centred methodology. The enhanced mock-ups and dashboards presented in this deliverable are relevant to end-users who will be involved through all project phases to highlight the usability of the mock-ups but also the usefulness of the system and the added value of this tool in cognitive impairment.

In this deliverable, enhanced mock-ups, and dashboards of tasks T2.3 will be presented and explained. Before presenting these screens a short reminder on the extracted user needs and requirements will be provided.

### 1.1 Intended Audience

This document is of interest to all those who are in contact with elderly person suffering from cognitive impairment: formal or informal (relatives and friends) caregivers, doctors, hospitals, care centres or insurance companies. Anyone interested in innovative projects related to digital assistance and transitional care or interested in the new technologies' contribution in a care field, will also be interested in reading this document.

### 1.2 Relations to other activities

The WP2 "End-user continuous involvement and co-creation" main objectives are firstly to set up end-users needs and technical requirements, but also to build a first draft of the solution using mock-ups. The aim of WP2 is then to create a first version of the engAGE solution, to present it to end-users during evaluation periods. WP2 is then firmly linked to the WP3 "Testing & Evaluation", as it will serve as a basis for end-users meeting but is also linked to WP1 as it will guide technical partners on how to develop and integrate the requirements wanted on the engAGE system.

### 1.3 Document overview

The Deliverable D2.3 is organised as follows:

- Section 2 presents the summary of the requirements established for the mock-ups;
- Section 3 presents the enhanced set of mock-ups and dashboards (screens from Pepper's tablet, from the mobile application gateway and the MEMAS application);
- Section 4 presents the heuristic evaluation protocol to be used by end-user partners;
- Section 5 concludes the deliverable.

## 2 Requirements summary

According to deliverables D2.1 and D2.2, the end-users needs, and requirements have been categorised in 4 different sections:

- **Motivational:** SMCI must be cheered while playing, but the system must not be childish
  - Games and cognitive stimulation must be available in the institution and at the SMCI's home to motivate them to use the system at home too
  - Have some motivational quotes to help the senior if he/she doesn't feel well, was wrong or needs help to go through the exercises; to make it more alive
  - SMCI's must be motivated to do more physical exercises, depending on their score and mobility capacities the system should push them to go through physical exercises
  - System must provide some gamification to motivate SMCI's to achieve goals and don't give up
  - Motivation settings must not be offensive or infantilizing
- **Analytic:** the system must provide some score and guidance on the cognitive state to know if it's maintained or not
  - The system must inform on the progress or regression of the SMCI's cognitive state
  - engAGE system must be able to spot alarm signs, by taking the information of the recorded scores and forwarding it
  - The well-being of the SMCI must also be analysed, it would help to provide some motivational quotes
  - Carers must have access to the data gathered by the system at any time, so they can have an eye on the system analytics and follow up by their own
  - A history of SMCI's actions and scores should be added to the system, end-users must be able to read their score and be aware of the games already done and the levels completed
  - The platform should monitor sleeping, physical activity and movement habits; vital signs (heart rate, blood pressure, blood oxygen level, etc); state of IoT devices and their connectivity and warn relevant personnel of persistent errors.
  - Bad results should come with recommendation and not be scaring
  - All data collected must be securely stored, and accessible by authorized and authenticated users.
- **Design:** most use cases regarding seniors must be included and some features must be specially designed for the target audience
  - Motivational settings must be customized or personalized to offer a better adherence (SMCI's can have a system that matches with them)
  - The design must consider the security of data. Data gathered by the system must be secured and only used for analysing SMCI's situation
  - Indicators must be designed to help SMCI to complete a game, but also gamification must be part of the game process to maintain SMCI's interest
  - Interfaces must be readable and funny to use to have a better adherence
  - The graphic elements should be spaced, the font should be big enough, with quiet music in the background to help SMCI to remain calm and don't feel disoriented

- The system should be designed to offer SMCI control on the information gathered (clickable options to share scores, share cognitive analyses or well-being evaluation)
- Interactions should be designed in a way for SMCI to feel qualitatively supported as well by the machine as by a human
- Formal carers need a system simple to use and non-time-consuming
- Self-reporting for primary end users, for cognitive function and perceived health and wellbeing should be provided.
- Video meetings for video calls to friends and family must be available
- **Training:** SMCI and carers must be trained or encouraged to use the system, ideally with a chat-box or any digital solution
  - The aim of the training is to maintain SMCI's cognitive state and try to improve it
  - Informal carers must receive motivational tips and advice to better face their beloveds' cognitive deterioration, it will be a kind of training for them in which they will find supportive actions they can reproduce
  - The system must suggest SMCI's games and levels of difficulties depending on the results obtained, it would by the way also train them to better understand how to select games depending on their state of mind
  - Interfaces and the information should not be intrusive but must reassure and encourage SMCI to use the system, SMCI don't have to feel forced to play a game
  - Training elements must provide enough satisfaction to help SMCI to accept the solution as a new tool and to be more confident to rely on technology
  - Formal carers feel the need to be trained to solve technical bugs on the system
  - Carers using MEMAS application must also be trained to configure the MEMAS client and adapt the services to the cognitive abilities of the SMCI.



### 3 Updated mock-ups and dashboards

The initial mock-ups have been created after two important tasks. The first one is the task T2.1 in which end-users' partners (HUG, KRD, and INRCA) had meetings with seniors with mild cognitive impairment and their carer. During this period, needs, challenges, expectations but also robot's actions have been gathered to present a use case scenario to technical partners. Results from T2.1 have been analysed by technical partners (TUC, IRIS, TLU and KRD) to identify functional and non-functional requirements to develop the engAGE system, in task T2.2. The analysis has been supported by end-users' partners who were more aware of the co-creation results and therefore useful to help on deciding what would suit SMCI the best.

The following sub-sections presented the enhanced and updated mock-ups and dashboards that consider all iterations and design improvements in the development of the prototype in WP1 as well as early feedback from end-users.

#### 3.1 Social Robot Coaching and Cognitive Stimulation

Social Robot Coaching and Cognitive Stimulation (SRCCS) will create interactive functionalities for Pepper Robot to act as a companion for the older adults. The Pepper robot has the advantage of having a tablet on its chest, which will serve to display several contents and screens. To be sure that the design and UX of the content are readable and appreciated by SMCI, different screens have been created.

##### 3.1.1 First interaction

The Pepper robot must be able to start an interaction or to understand when an SMCI wants to interact with it. The first screen appearing must then be filled with some general information: place where the person is located (name of the institution), clear references to the current date and time (basic information) and an information button, which can link the SMCI to the engAGE website, a demonstration video, etc.



Figure 1: Screen of presentation

Different screens will appear depending on the seniors' answers. When the answer is positive, they will be automatically derived to a screen asking them if they are a new user or if they had already been registered in the system. If the answer is negative, the robot will present a screen to say goodbye to the SMCI. As they suffer from cognitive impairments, an added button, comparing to the last screen, will be provided: "I don't remember". Now the information button has turned into a help button, which will serve to call formal carers of the institution to the rescue.

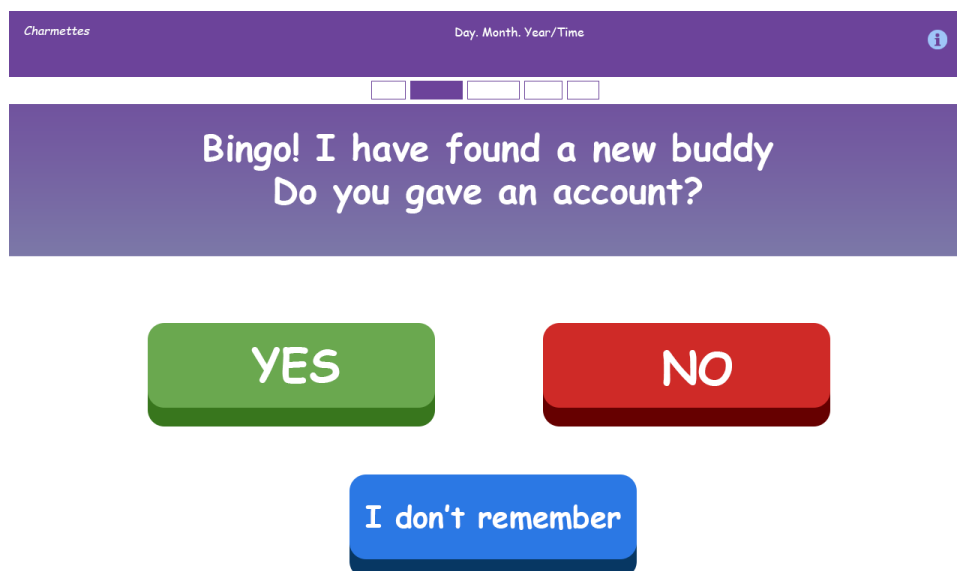
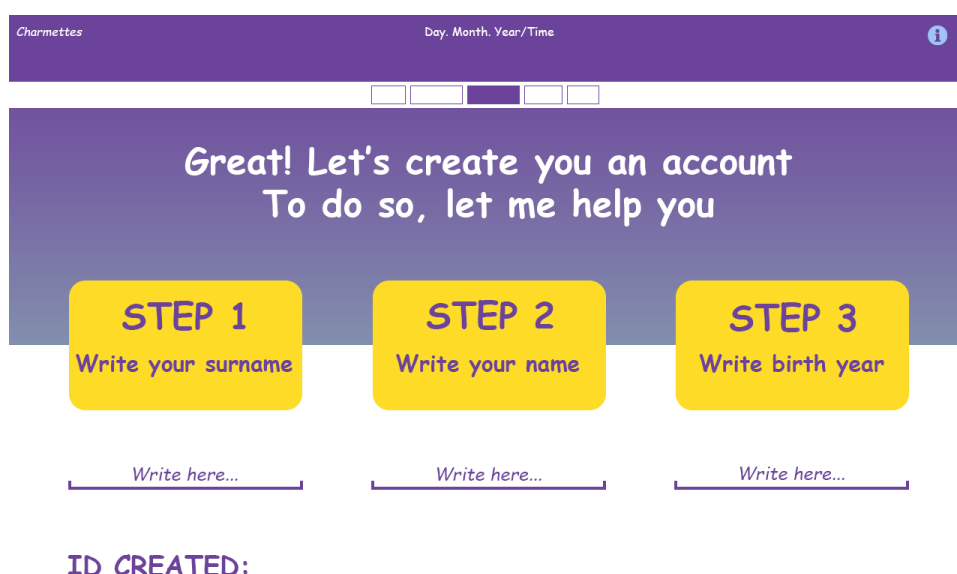


Figure 2: Follow-up screen asking for existing account

### 3.1.2 ID logging / account

Depending on the previous answer of the SMCI, the senior will have to enter his/her ID. If the SMCI is a new user, a screen with three steps to do will appear, to help the senior to create a secure but easy account to remember.



**ID CREATED:**

Figure 3: Help to create an easy to remember and secure ID

The step 1 asks the senior to write her/his surname, step 2 the name and step 3 the birth year. When the senior will complete these 3 steps, an ID will be automatically generated. Once the whole blocks completed, an announcement will appear to inform the senior on his/her registration, in which the “ID created” will be repeated. It will help the senior to remind him/her the username.

All accounts will be composed of their first name-surname-year of birth. For example, *JackJohnson1944*.

### 3.1.3 Profile – Dashboard score

The following screen will allow the SMCI to complete their profile. They will be asked to save their birth date, the place they are living and their phone number. If they want, they can also take a picture of themselves to save on their profile. They will also have the possibility to enter data of their informal carer: name, surname; phone number, living city. Maybe a carer must assist in creating user information, both for the SMCI and the carer. So, if an emergency or a problem occur, relatives can be notified.

Figure 4: Profile screen

When approaching the information button or when arriving on this screen, a pop-up message will appear aside the information button. The pop-up will announce that by clicking on the information button, end-users will find information about the data storage and security. Also, instead of a green button “play” a “save button” will be displayed on the bottom right.

### 3.1.4 Cognitive games’ menu

Once the account is created, the profile completed, the engAGE user will arrive on the cognitive games’ menu. On this screen the 4 different types of games will be displayed with nice pictures illustrating them. On the screen, SMCI will have to click to choose between: familiar games, quizzes, physical games, and story/plays telling. Once the game selected, SMCI will have to click on the green button to start the game.

Once the type of game selected, the SMCI will be redirected to a new screen in which all the games corresponding to the type selected will be displayed (see Figure 5). Notice, that on the top of the screen, the ID of the senior will be shown. The purpose of displaying their ID is to help them to

remember it by themselves. It’s also a basic information that is needed for this kind of target group as they often feel lost, disoriented, or don’t remember what they were doing.

NOTE: The actual implementation may differ from this. An overriding principle for services to people with MCI is to keep the interface very simple. Not overload it with unnecessary information.

- If the SMCI selects the “*Familiar games*” (to be understood as known and often played games and not as family games), 5 different games will appear. The SMCI will then have the possibility to choose between: crossword, karaoke, memory card, sudoku, 7 difference game.
- If the SMCI selects the “*Quizzes*”, 3 different games will appear. The SMCI will then have the possibility to choose between: a picture quiz, a musical quiz, or a cultural quiz.
- If the SMCI selects the “*Physical games*”, 3 different games will appear. The SMCI will then have the possibility to choose between: *miming*, *dancing*, and *yoga*.
- If the SMCI selects the “*Story/play telling*”, 2 different games will appear. The SMCI will then have the possibility to choose between: story listening or plays/poems reciting.



Figure 5: Screens of the selected game

A “back” button will be displayed on the bottom left, so they can easily return to the game’s menu if they want to change the type of game. On the opposite, bottom right, a green “play” button will appear, to start the game that has been previously pre-selected.

### 3.1.5 Settings

The settings screen will allow end-users to set the brightness, the speakers volume, and the language. It may be difficult for them to slip the little dot to vary the brightness and the sound, we suggest then to make it possible to click on the icons to gradually do the setting ups. The settings will be provided in the MEMAS administration module.

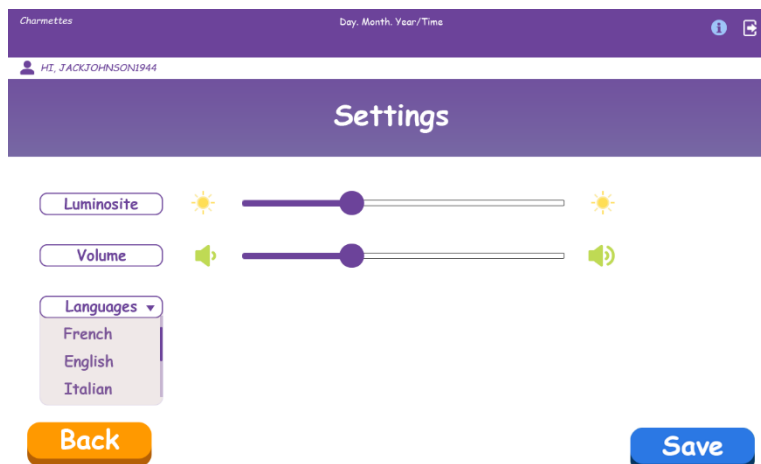
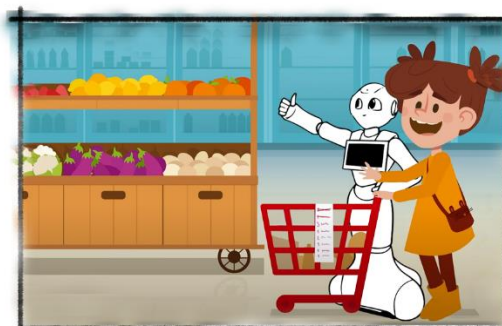


Figure 6: Screen of the settings

### 3.1.6 Playing games

For the first prototype we have developed two memory games in which end-users with MCI are invited to practice their memory in an active, interactive way, guided by the Pepper robot.

- **The Shell Game (or the Glasses Game)** is a memory game in which end-users will find themselves in common contexts of everyday life (e.g., shopping, at home) and will have to remember under which of the glasses they can find the object they are looking for. To earn winning points, the end-user must select the correct cup containing the desired object/product.



AS IT WAS ALMOST TIME FOR THE GRANDPARENTS TO ARRIVE AT OUR HOME, WE WENT STRAIGHT TO THE FRUITS AND VEGETABLES STAND.



LET'S FIND OUT TOGETHER WHAT PRODUCTS ARE MISSING AND RECOVER THEM. ARE YOU READY?

Figure 7: Story frames of the game

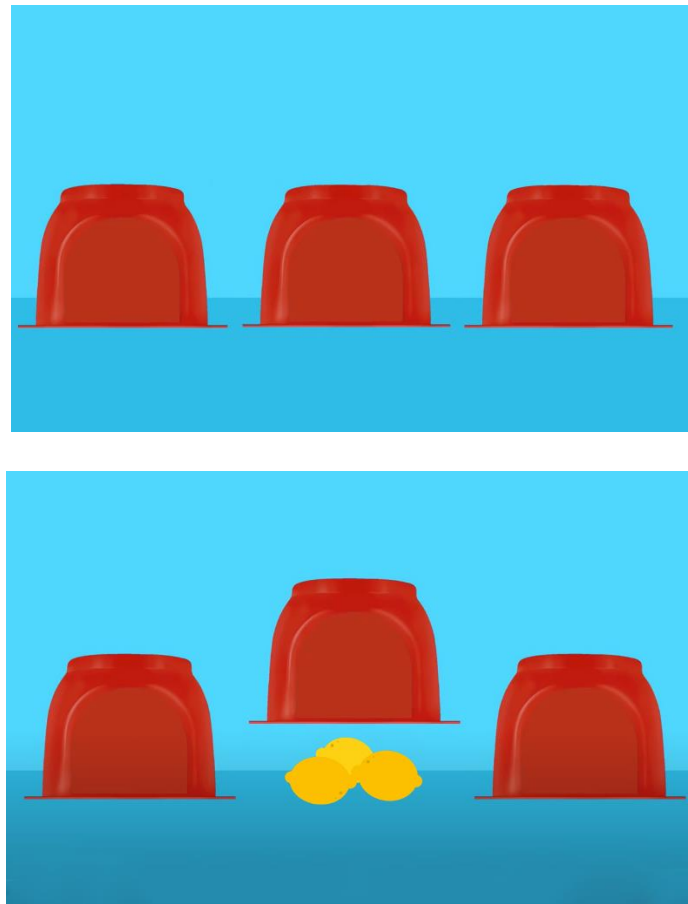


Figure 8: Mixing glasses and the selection of the response

- Sensors-Memory Game** is an interactive game that uses many sensors and elements of Pepper robot, such as tactile sensors on the robot's hands, head, and base, led on robot's ears, the tablet, voice communication and movements. Using the previous elements, it will exercise the end-users' memory. If a colour or a sequence of colours is displayed on the robot's ears, the end-user will have to remember them and select the correct answer on the robot's tablet.

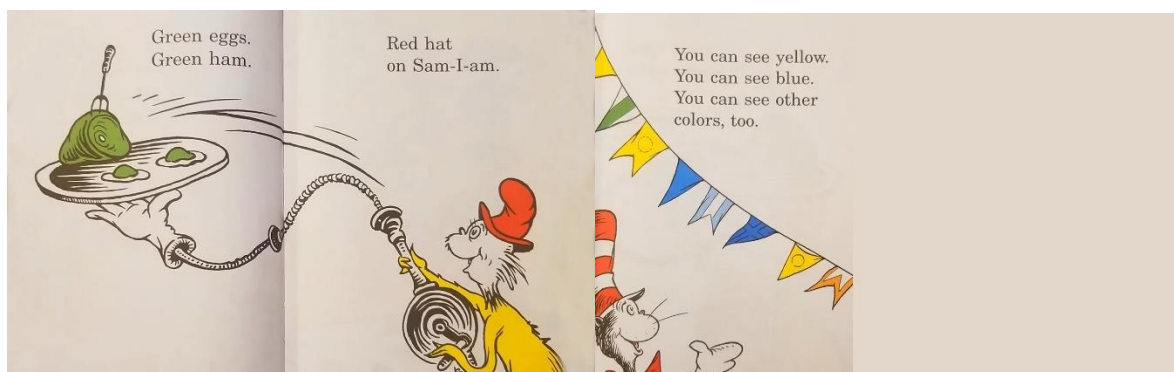


Figure 9: Story of the sensors game

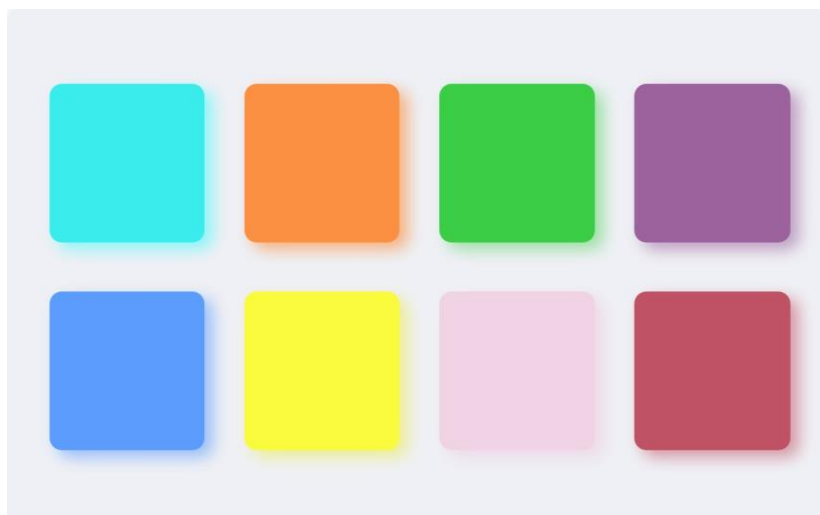


Figure 10: Choosing the colour displayed on tablet

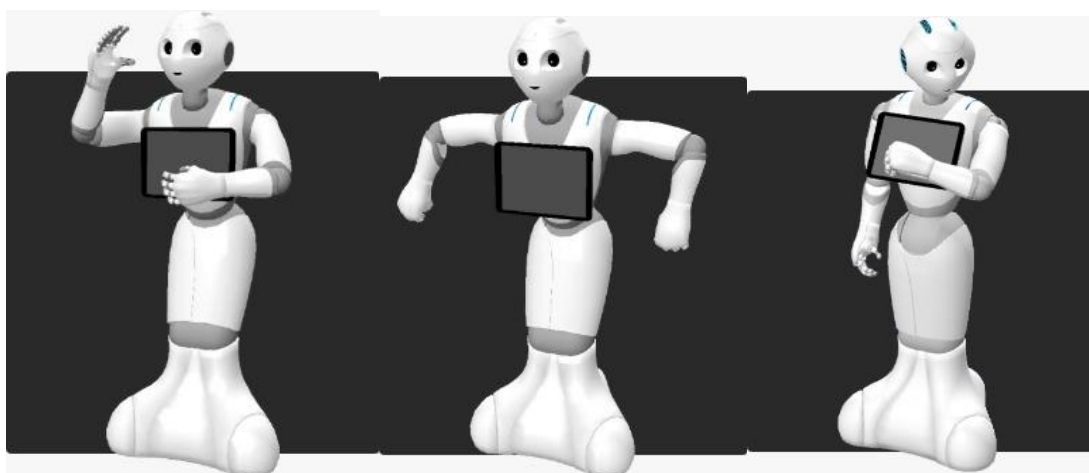


Figure 11: Choosing the position of Pepper

## 3.2 Monitoring, Self-Reporting and Big Data Processing

The Monitoring, Self-Reporting and Big Data Processing (MSRBD) service has little user interaction outside of the use of sensor devices. The service features a mobile application gateway which transfers data from sensor devices and into the cloud (see deliverable D1.1). In the first iteration, the user wears an activity tracker, and the mobile app transfers activity tracker data from the Fitbit service and into the MLCDA service of engAGE. It does so automatically while running in the background on the mobile device of the primary user. There is a one-time initiation where the user needs to authenticate with both TelluCare and the Fitbit service. Thereafter the user does not normally need to interact with the app, but it needs a user interface to show status and allow turning data transfer off and/or logging out of accounts. The user is notified of any errors in the data transfer with notifications on the mobile device. The mobile app is an engAGE-specific development of Tellu’s Dialogg app, which is TelluCare’s mobile interface for patients. This can be extended with more functionality in later iterations.

### 3.2.1 Logging in

The first time the app starts, you are asked to enter the name of the service it should connect to. Enter “engage”. You then get the initial landing page, with a button to log in (see Figure 12). The button launches the user authentication. For security reasons, the authentication is done in the web interface

of an authentication service, not in our app. An example of a user authentication screen is shown on the right side of Figure 12. For the initial prototype we use a Dialogg username and password, as created in TelluCare. Once signed in, the user will stay signed in until explicitly signing out or the authorization service decides the session has expired, so a user should not need to sign in again during a trial.

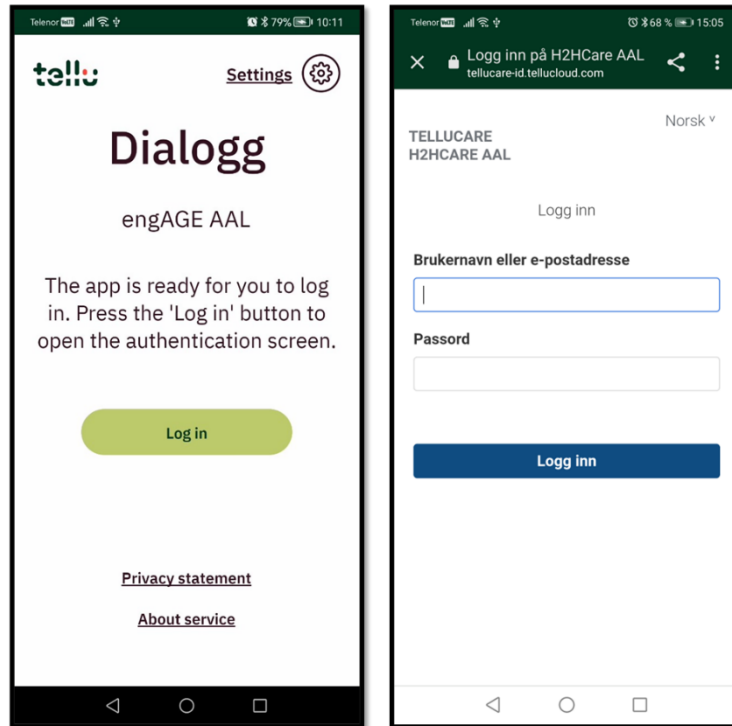


Figure 12: Logging in to the Dialogg mobile gateway app

### 3.2.2 Gateway page

When using the engAGE service, the main page of the app is the gateway page (Equipment gateway). From here you can connect equipment and turn the gateway on and off. Depending on what equipment has been connected, the following items can be available here:

- Gateway On/Off: Switch to toggle data transfer. If on, the gateway continues to run in the background, to check the status of connected devices and transfer data when available. Of course, this does nothing until a device has been connected.
- Your equipment: Once devices have been added, these are shown here. Currently we will only use a Fitbit tracker, and it will be listed here once added. The item has a status colour and a status text.
- Add new equipment: Options for connecting equipment are listed here. The option to connect a Fitbit account is given here when not already done. No other devices will be used in the

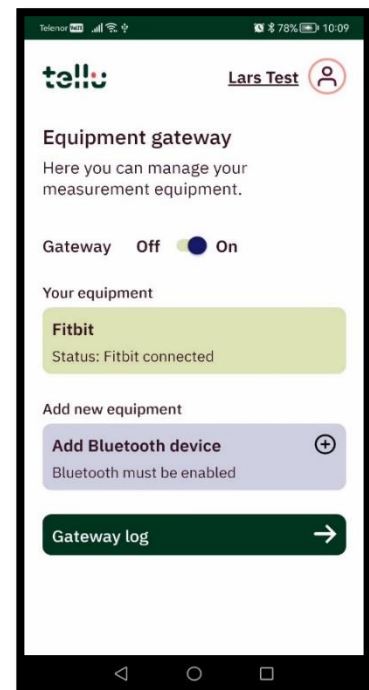


Figure 13: Main gateway page



first prototype iteration, but Dialogg also has the option of connecting various Bluetooth devices.

- Gateway log: Opens the gateway log page, which lists operations performed by the gateway.

In addition, there is a clickable field in the top right corner of the app. This has the name of the logged in user and a user profile icon. This brings up a secondary menu, with less important features of the app, related to user profile and settings.

### 3.2.3 Profile & Settings

The profile and settings are available from the top right of the main gateway page. It has a button to log out, in case you need to switch account or stop using the app. The rest are a set of standard features of the Dialogg app, which are not normally needed by the primary user in engAGE.

- Care profile: Shows information stored about the patient in TelluCare (not currently used).
- Notifications: Settings for receiving notifications from TelluCare (not currently used).
- Auditlog: Log of who has accessed a patient's data in TelluCare.
- Status: Shows various status information about the app and service. Useful for debugging errors.
- Privacy statement: Web page with TelluCare's standard privacy statement.
- About service: Web page with TelluCare information.

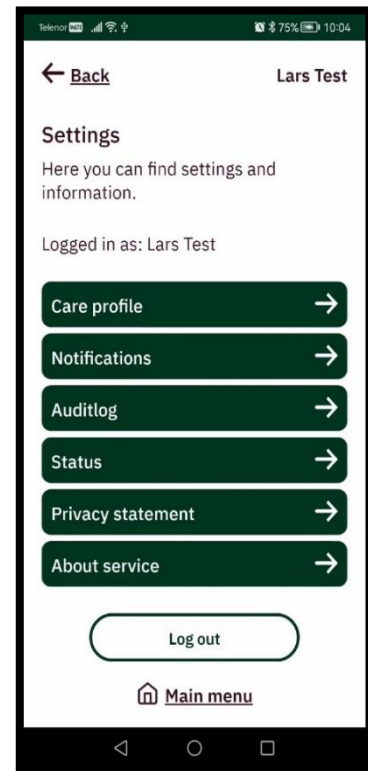


Figure 14: Profile and settings menu

### 3.2.4 Fitbit activity tracker

For engAGE, Dialogg should be used to transfer data from the Fitbit system, which means we need to set up a Fitbit bracelet and account and then connect the Dialogg gateway to that Fitbit account. Note that we can't access the Fitbit device directly, only the web API of the Fitbit service. The Fitbit must be used normally, paired with the Fitbit app, so that data is gathered by the Fitbit service. You can then grant access to this data to engAGE through the Dialogg app. This means that the Fitbit app does not have to run on the same device as Dialogg – you could have Fitbit on your personal phone and test Dialogg on a tablet. However, it is recommended to have both on the same device, at least to test the role of the elderly user.

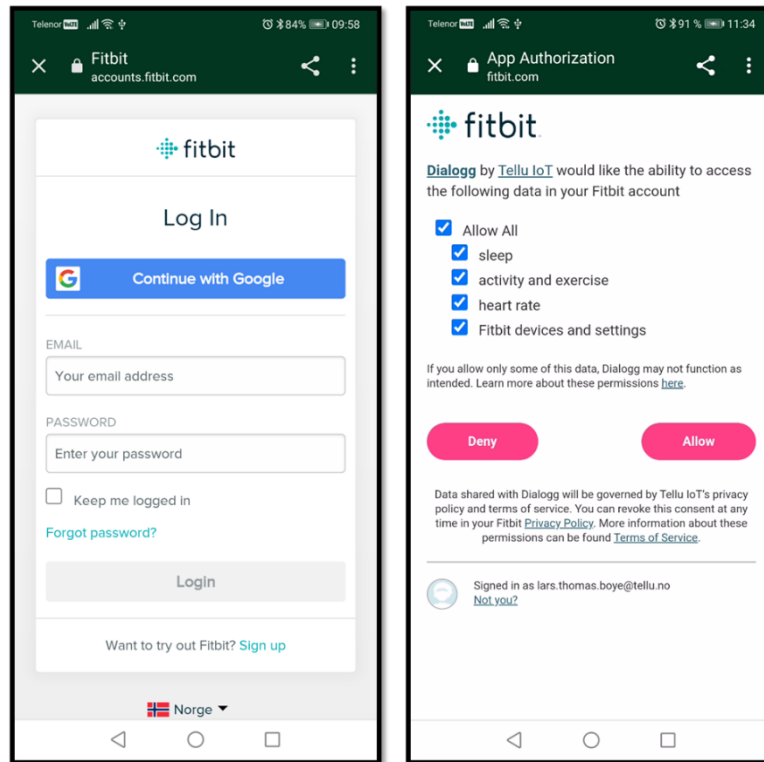


Figure 15: Fitbit authorization screens

#### 3.2.4.1 Fitbit setup

1. Charge the Fitbit with the cable.
2. Download the Fitbit app on the phone or tablet (search for Fitbit in Google Play).
3. Create a Fitbit account in the app, unless you already have a Fitbit account you want to use. This needs an email and password, used to log in.
4. Follow the instructions in the app to set things up. You are asked to enter height and weight, and to connect the Fitbit to the phone. It may ask you to unlock Fitbit Premium, but this is not needed.
5. Open the Dialogg app, logged in with the Dialogg account you will use.
6. Select Connect Fitbit on the Equipment gateway page. This opens a Fitbit screen, with some information and the status.
7. Press the Connect button to connect a Fitbit account to Dialogg and the engAGE system. This opens a web view for the Fitbit service (this is not part of Dialogg). You may be asked to log in with the Fitbit username and password. Next, you are told which application is requesting access and to what data. Give access to the requested data (select Allow All and press the Allow-button).
8. After connecting, the Fitbit page in Dialogg should show the status as Connected, and there will be a button to disconnect. The main Equipment page will list the Fitbit as connected.
9. On the Fitbit page, there is a button to Test connection, which can be used to check that data can be transferred from the Fitbit service.

#### 3.2.4.2 Fitbit usage

Once the Fitbit connection has been made, the gateway can be turned on with the switch on the main page. If the gateway is on, the app should regularly check in with the Fitbit service to check status and

transfer data when available, even when the app is closed, and the screen is off. It is scheduled to do this once per hour, although it is ultimately up to the Android system whether scheduled background tasks are run or not. The result of the Fitbit transfer task is logged in the gateway log each time it completes, so you can see in the log if it has been running or not. If the task ends with an error, a notification is posted in the Android notification system. If no notification alerts the user, all should be well, and the user does not need to interact with the app. However, the version of Android and any power-saving settings made in the Android settings can affect the running of tasks in the background. You should not enable any power-saving options or restrict the app from running in the background. And it is a good idea to open the app occasionally (every one or two days), as this makes sure the Fitbit transfer task is restarted, if it had stopped. Then you can check the Fitbit status and the gateway log, described below.

For how to use the Fitbit bracelet and Fitbit app, you may want to consult the Fitbit documentation. We only got a minimal Product Information booklet in the box, but a full manual can be downloaded from fitbit.com. If data is not being transferred, you should always check the Fitbit app first, and make sure it has the latest data, as it will only be available to Dialogg and engAGE once the Fitbit app has transferred it into the Fitbit cloud.

### 3.2.4.3 Fitbit status

The Fitbit item, listed under Your equipment on the main gateway page, has a status colour and a status message. Press this item to open the Fitbit page, which shows more detailed status. The status is based on the Fitbit device data reported by the Fitbit service (if multiple Fitbit devices have been connected to the Fitbit account, we use the most recently seen device). These are the properties showed on the Fitbit page:

- **Device:** Model name of the Fitbit device.
- **Device synced:** Date and time for the last time the Fitbit app sent data to the Fitbit service.
- **Battery:** Percent remaining battery reported by the device on last device sync.
- **Last transferred:** Last date for which data has been transferred from the Fitbit service and into engAGE. Data is transferred for a whole day, and only once at least 10 hours has passed since the end of this day, so this will be at least one day behind the current date.
- **Status message:** Short text describing the current state.

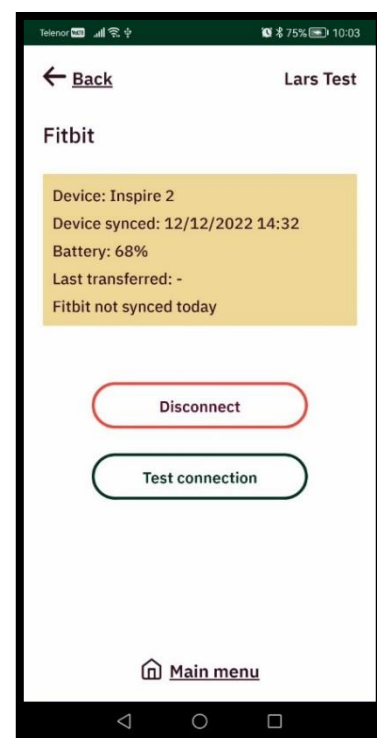


Figure 16: Fitbit page

The status colour and message are meant to indicate any known issue with the device and its connectivity. The status field is green if all is OK, yellow for various temporary issues (see status message) and red for a more serious error. It is grey if Dialogg does not have a Fitbit account. The possible status messages are explained in the table below.

Table 1: Fitbit status messages

Status message	Notes
No Fitbit account	Press Connect Fitbit to connect to a Fitbit account, needed for Fitbit functionality. If this has been done previously, the authentication has expired, so you will need to connect again.
Fitbit device not connected	No device sync (Fitbit app sending data to the Fitbit cloud) for at least three days. If you are using a Fitbit, the Fitbit app has stopped syncing data. Please open the Fitbit app to restart syncing, and check it gets data from the Fitbit device.
Fitbit auth. expired	Fitbit authentication has expired. Dialogg tries to refresh the authentication automatically, but if this fails you will need to reconnect the Fitbit account.
No Fitbit found	Dialogg has not received information about any Fitbit device from the Fitbit cloud. Make sure the setup is correct – that the connected Fitbit account is also used in the Fitbit app, and that the Fitbit app is connected to the Fitbit device.
Fitbit not synced today	No device sync (Fitbit app sending data to the Fitbit cloud) on the current date. This becomes a red error if it persists for three days. Please open the Fitbit app to restart syncing, and check it gets data from the Fitbit device.
Fitbit battery low	Battery level reported in the last sync was below 15%. Please charge the Fitbit device.
Fitbit connected	No issues – all OK.

#### 3.2.4.4 Gateway log and notifications

While the app is connected to a Fitbit account and the gateway is on, it will regularly check the Fitbit cloud service for the latest information. It checks the Fitbit authentication, updating it if necessary, and retrieves the Fitbit device/status information. Actual data transfer – getting all the monitored data from the Fitbit cloud and transferring it into the MLCDA service of engAGE – is only done once per day. The data for a specific date should be transferred during the next day. The app waits well into the next day to make sure the Fitbit app and cloud has had time to transfer and process all data for that date. The app also checks the data for completeness, waiting for all data to be available. Every time this background task finishes, the result is logged in the gateway log. Possible result messages are listed in the table below. The result is considered either successful (green in the table), a temporary issue (yellow) or an error (red). A temporary issue is considered an error if the failure to transfer data persists. If the attempt ends with an error, a notification is posted in the Android notification system to alert the user of the failure to transfer data. The log message contains the details – open the Gateway log and select the latest issue to see any details.

Table 2: Data transfer result messages

Log message/notification	Details/notes
Updated Fitbit status	OK – no need to transfer data at the current time.
Fitbit data transfer completed successfully	Successful transfer of data to MLCDA (for one date).
No Fitbit found	No Fitbit device information found. Make sure that you have a Fitbit device connected to your Fitbit account, and that your app device has an internet connection.
Fitbit not synced today	No recent Fitbit data is available. The Fitbit app needs to transfer data from the Fitbit device. Please open the Fitbit app to make sure the Fitbit device is synced with the app, and check if today's data is shown. Try again once the Fitbit app is updated.
Failed to get Fitbit data	The retrieval of data from Fitbit cloud failed. This may be a temporary network or service problem.
Failed to send data to MLCDA	Data was retrieved but posting it to MLCDA failed. This may be a temporary network or service problem.
No heart rate in activity data	Resting heart rate is not available. This indicates that either Fitbit wasn't used, or the data hasn't been synced by the Fitbit app. Please check the Fitbit app.
No steps in activity data	No steps were registered for the transfer date. This indicates that either Fitbit wasn't used, or the data hasn't been synced by the Fitbit app. Please check the Fitbit app.
Sleep data was missing	No sleep was registered for the transfer date. This indicates that either Fitbit wasn't used, or the data hasn't been synced by the Fitbit app. Please check the Fitbit app.
Fitbit data sync failed	The app was not running or logged in. Please open the app.
	No Fitbit authentication. If you have connected a Fitbit, the authentication has expired. Please connect to a Fitbit account to transfer data.
	Fitbit authentication failed. You may need to reconnect the Fitbit account.

### 3.3 Communication Platform and Intelligent Personalization

The Communication Platform and Intelligent Personalization (CPIP) consists of several dashboards that will be developed and integrated with the related components to show information concerning the cognitive baseline, ADL monitoring, self-reporting, and cognitive decline assessment and to enable interaction and communication of all types of interested actors with the system. The platform will be based on the Karde product Memas which is a Life Mastering Assistant or a cognitive aid that is suitable

for many different users in different life situations. It could just as well be older people who don't remember very well (people with MCI), or young people who need structure in their everyday lives.

The Memas system contains functionality which will help people e.g., with MCI:

- Calendar with reminders
- Step by step instructions for daily activities in form of series of images with spoken comments or videos
- Pleasure functions
  - Photos with spoken comments and videos
  - Music
  - Easy access to radio channels
  - Easy access to network newspapers
  - Cognitive games
  - Training exercises
  - Weather forecasts
- Self-reporting, how you feel
- Very simple to operate video communication system

The Memas system is divided into (1) a web-based administration module, Adminweb, where secondary users can configure the service which is visible on a (2) physical device, usually a tablet, which are made available to the primary user.

Memas operates with two types of users: Primary users and secondary users. The primary user is the person with MCI who physically owns a device with a MEMAS client, and who uses MEMAS as an aid to organize their everyday life. Secondary users are relatives and others in the support system around the primary user, who assist with this in various ways. A primary user can be connected to several secondary users. A secondary user can assist several primary users.

In Adminweb, the secondary user can manage an activity calendar, build albums with photos and videos, configure access to favourite radio channels and newspapers etc. As the cognitive state of the person with MCI deteriorates, the secondary user may remove some of the Memas functionality from the primary user's device.

In the first version of Memas, which was developed in collaboration between companies and dementia organizations in Germany, Great Britain and Norway, with KRD as coordinator and project manager, extensive user tests were carried out in all countries.

The images shown below are taken from the present version of Memas. It is now undergoing a modernization, and the HCI in engAGE will be different, though the content will fairly much be the same.

### 3.3.1 [The web administration module](#)

The Memas system is configured by the secondary user for the primary via Adminweb. An adaption of this module will be added to the engAGE solution because it offers a way of security and allows carers and relatives to set important information for the primary user. By its features, Memas will help primary users to feel sustained and carers to gain power to act.

Figure 17 shows the screen for secondary user logging in to Memas the first time:

1. Log in with your Google account
2. Register more information about yourself (Address/tel.)
3. Choose which agreement you want (30-day trial, recurring monthly subscription, ongoing annual subscription)

HOME ABOUT MEMAS PRIVACY EØ : ☰

---

Registration of secondary users

Name	Erlend Øverby
Email	erlend.overby@hypatia.no
Address	<div style="border: 1px solid #ccc; padding: 2px;">Address Åsgårdveien 24</div>
Post code	<div style="border: 1px solid #ccc; padding: 2px;">Post code 1671</div>
Place	<div style="border: 1px solid #ccc; padding: 2px;">Place</div>
Country	<div style="border: 1px solid #ccc; padding: 2px;">Country Norge</div>
Phone	<div style="border: 1px solid #ccc; padding: 2px;">Phone 90129642</div>
Agreement type	<div style="border: 1px solid #ccc; padding: 2px;">Agreement type 3 Month subscription - auto renewal</div>

First time registration

Figure 17: First time registration in Memas Adminweb

When the secondary user is registered in the Adminweb, then she/he can register primary users as indicated in in the Adminweb screen in Figure 18:

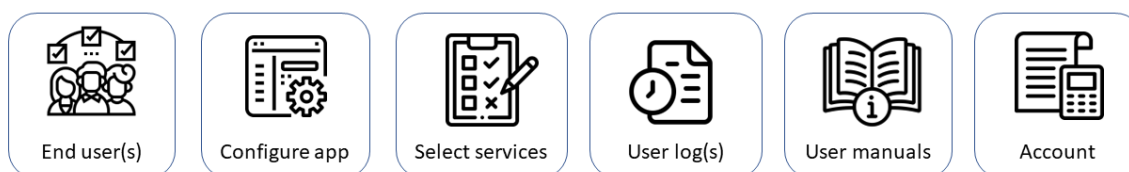
- The upper row of options is for administration of the Memas system.
  - End users(s): You can define and delete primary users, share primary users with other secondary users (family/institution)
  - Configure app: Potential technical issues (network devices etc.)
  - Select services: In the bottom row you see the offer of services available to the primary users in the Memas-app. However, you may remove some and don't let the primary user have access to everything. When the dementia state deteriorates, you may delete some services because they are of no interest any longer.
  - User log(s): Give an overview of the usage of services. E.g., if some services are never used by the primary user, they could be deleted as a choice for this user in the Memas-app.
  - User manuals: Tells how the Memas system works

- Account: Details about the subscription.
- The lower row contains services to configure the system for the primary user.
  - Today: Add and delete activities in the calendar
  - Self-reporting: Specifically developed for the engAGE-project to enable the primary user to fill in and submit self-reports.
  - Brain training: To configure cognitive games for the primary user.
  - Daily help: Instructions how to conduct activities in the daily living, e.g., by a series of images with w\written or spoken commends or instruction videos. These instructions must be made by the secondary user.
  - Pleasure: May contain several services: Photo albums. Playing lists, Easy video communication, weather forecasts, access to radio channels, access to digital newspapers, training programs for physical activity, etc.
  - Contact me: A list of persons which should be contacted ig\lf the primary user needs help.

**memas**<sup>™</sup>  
Your memory assistant

### Welcome to Memas administration web!

Set-up and administer the Memas application:



Add and change app service content and update complexity:



Figure 18: Home page of Memas Adminweb

When the Primary user is registered in Adminweb (Figure 19), a registration code is shown. This registration code is used the first time the primary user accesses the Memas app. Then a relation is created between the Secondary and Primary user. Normally, the Secondary user will log in the Primary user the first time and enter the registration code.



HOME ABOUT MEMAS PRIVACY EØ : ☰

---

Registration of secondary users ↓

**Erlend Øverby** 📄

---

Registration of primary users

Name	Name Anne Øverby	
Email	Email anne@gmail.com	
Address	Address Furumoveien 17	
Place	Post code 2500	Place Tynset
Phone	Phone 43992233 <span style="float: right;">✕</span>	
Registration code	primaryuser.phonehint <b>N K B L 5 L T C</b>	

© V(0.0.4) Erlend Øverby 🇬🇧

Figure 19: Registration of primary user in Memas Adminweb

Figure 20 shows the monthly calendar in Adminweb.

HOME ABOUT MEMAS PRIVACY EØ : ☰

---

month ▼

februar 2023							
<<	<	februar 2023	>	>>			
	man.	tir.	ons.	tor.	fre.	lør.	søn.
6	30	31	1	2	3	4	5
7	6	7	8	9	10	11	12
8	13	14 <span style="color: red;">📅</span>	15 11:00:00-11:30...	16	17 10:00:01 Hair ...	18	19
9	20	21	22	23	24	25	26
	27	28	1	2	3	4	5

Figure 20: Monthly calendar view in Memas Adminweb

A specific calendar activity event is shown in figure below.

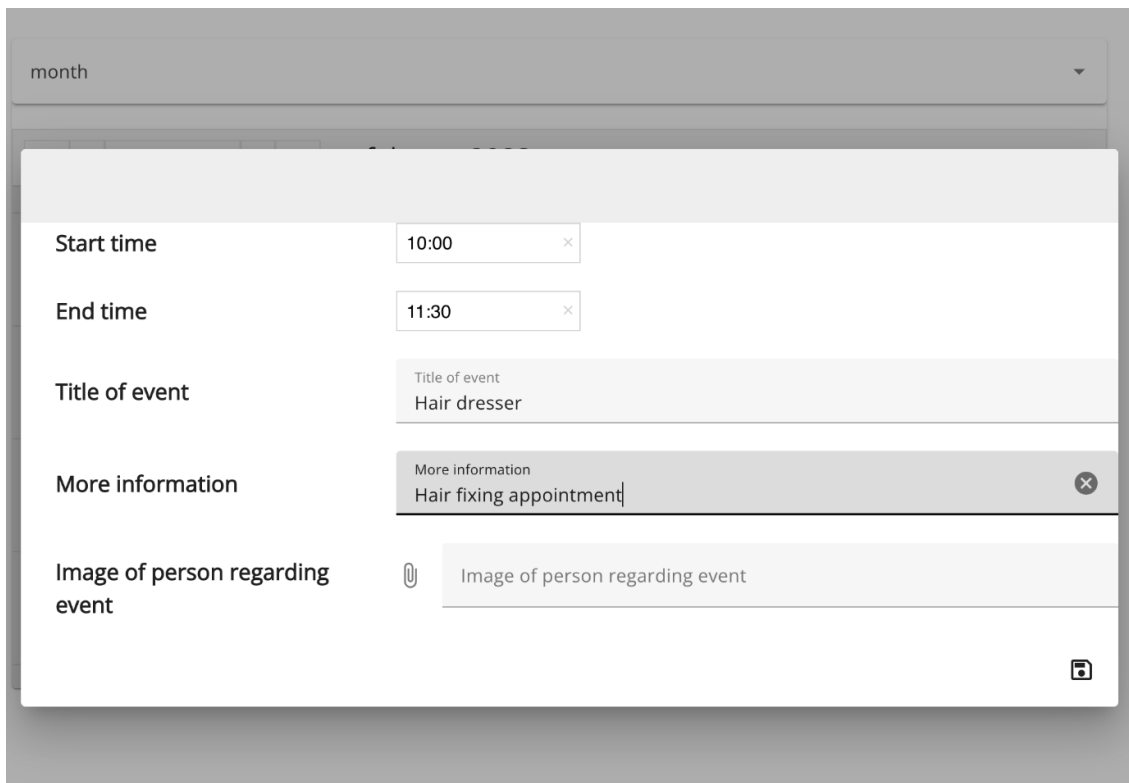


Figure 21: Calendar activity in Memas Adminweb

### 3.3.2 The client - tablet application

The Primary user will get access to the functions the Secondary user has configured.

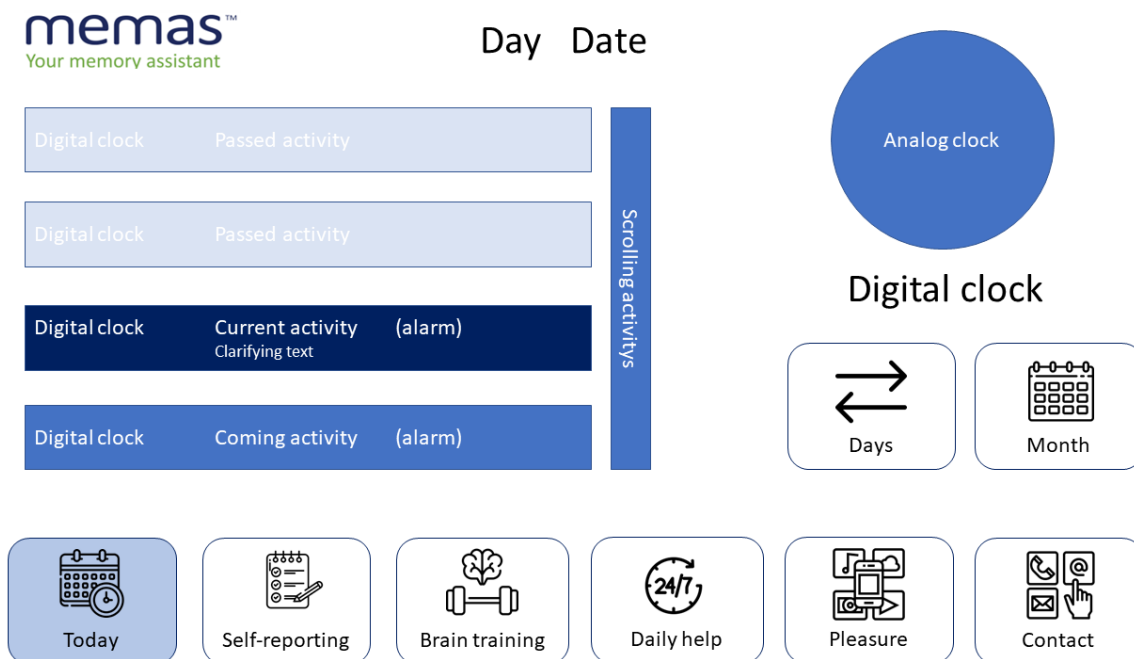


Figure 22: Home page of the Memas-app

Figure 22 shows a wireframe of the home page of the Memas app. It will always show the calendar of today. It also indicates the time and that it is e.g., morning or evening. In Adminweb you can select a digital clock or both. Passed actions will be turned into white/grey to inform the Primary user that it's no longer relevant. If the tablet has been inactive for some time (the duration can be configured in Adminweb), the MEMAS client will return to the today view.

On the home page of the Memas-app, you may navigate to all functions of the Memas system. If you want to see more details of the calendar, you push the arrows-button. If you want to see a monthly overview, you push the month-button. The calendar is shown in figure below.

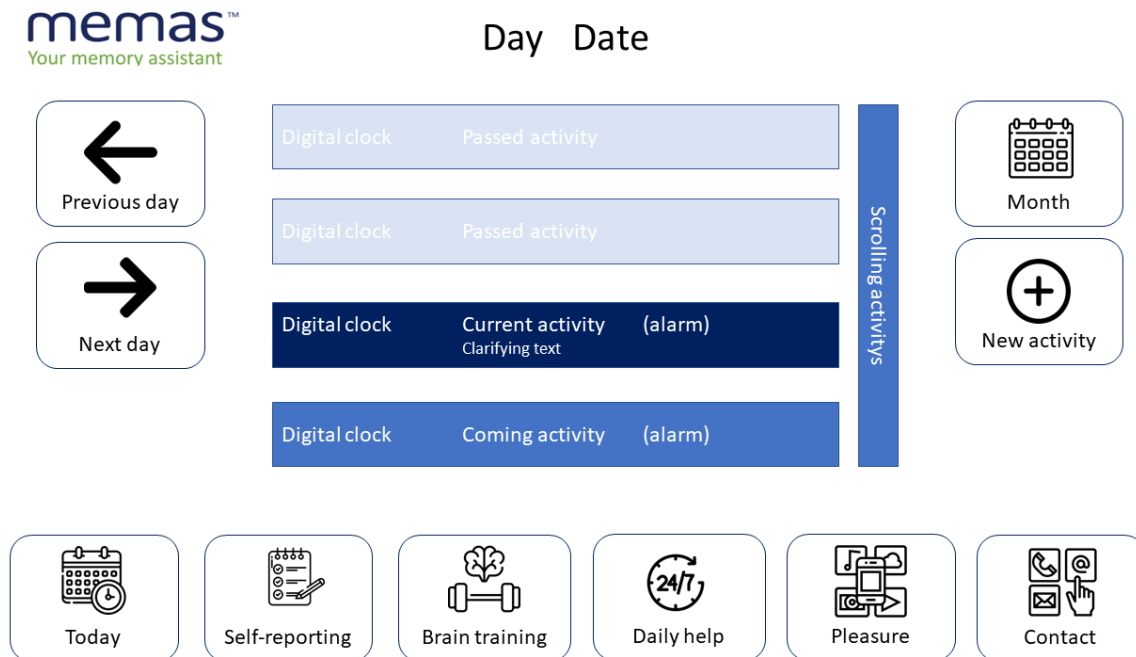


Figure 23: Day view in the Memas-app

Figure 23 shows the planning for the day, which has been entered into the system by carers and relatives from the Adminweb. Some people with MCI would like to enter activities themselves. This can be configured in Adminweb by the secondary user.

### 3.4 Types of Human-Machine Interactions

Different means are available to start an interaction between a human and a machine. Regarding Pepper possibilities, it can be nice to develop interaction means by including sound on the robot, body/head movement reactions to SMCI speech/actions/results, verbal sentences as follow-up answers, etc.

When the SMCI is playing and succeeding a task, the robot could say something like: "Well done". To be sure that the SMCI will understand what the robot says, the words can be displayed on the screen like subtitles.

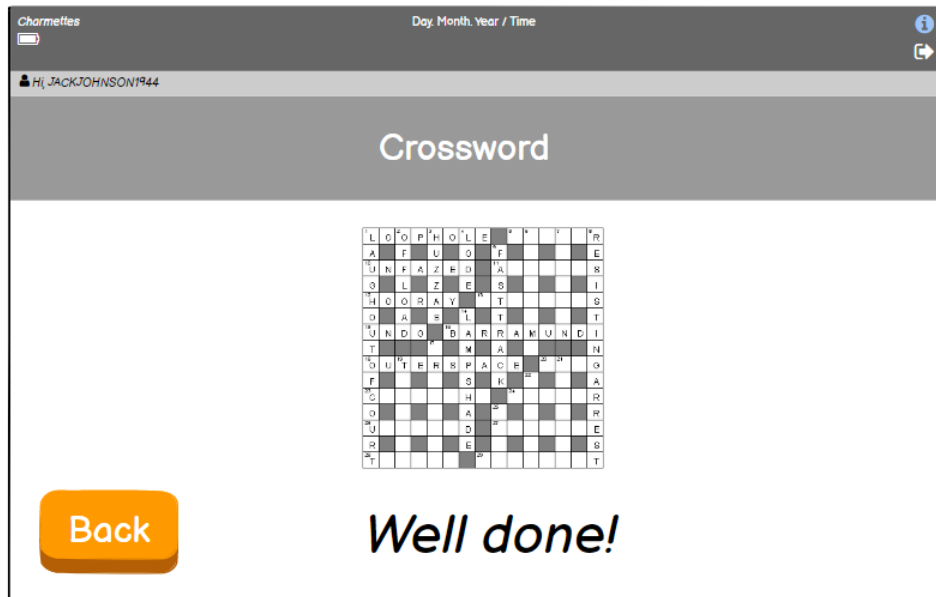


Figure 24: Robot's incentive

Alternatively, the robot can make a sound when the SMCI put wrong answers or vibrate or do anything that can signal SMCI that the system is involved in the game they are playing. The vibrations or sounds from the robot should be provided as options. SMCI will then be able to customise the robot according to their performances. SMCI can also choose to have a robot which won't react to false answers, as some will maybe find it childish or demotivating.

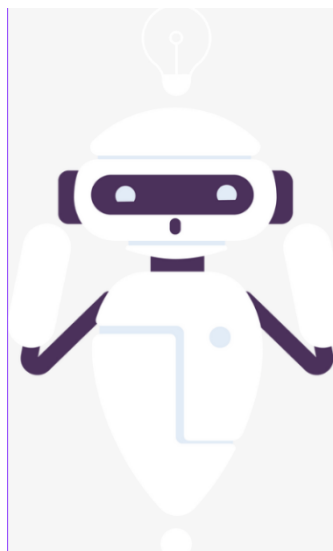


Figure 25: Robot making a sound or vibrating

To build an interaction between the robot and the SMCI, the robot can also greet the SMCI when it sees him/her, have a dance to welcome her/him, raise its arms in contentment.

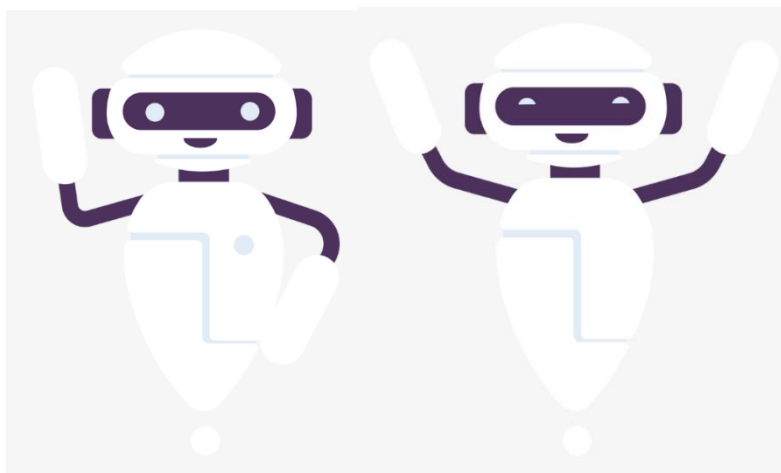


Figure 26: Body movement reactions

(Left: robot welcoming/greeting the senior; Right: robot dancing/cheering when SMCI succeeds a game)

Table 3: Listing of sounds the robot could do

<b>Greetings</b>	Hey! How are you! Hello! Happy to see you!	Robot raises its arms, shake its hand. Robot moves to the SMCI.
<b>Invitation to play</b>	You want to play with me today?	Robot tilts its head.
<b>Error's use</b>	Oh no! Oopsie! Try again!	The robot vibrates to indicate that an error has occurred.
<b>Success' use</b>	Wow! Congratulations! Well done! Good job!	If possible, the robot plays a short music melody when validating the answers. If the robot can have happy face expressions, it would be a must
<b>Farewells</b>	See you soon! Goodbye my friend! Bye! Take care!	Robot raises its arms, shake its hand. Robot moves to its base.

### 3.5 Types of support

#### 3.5.1 Cognitive

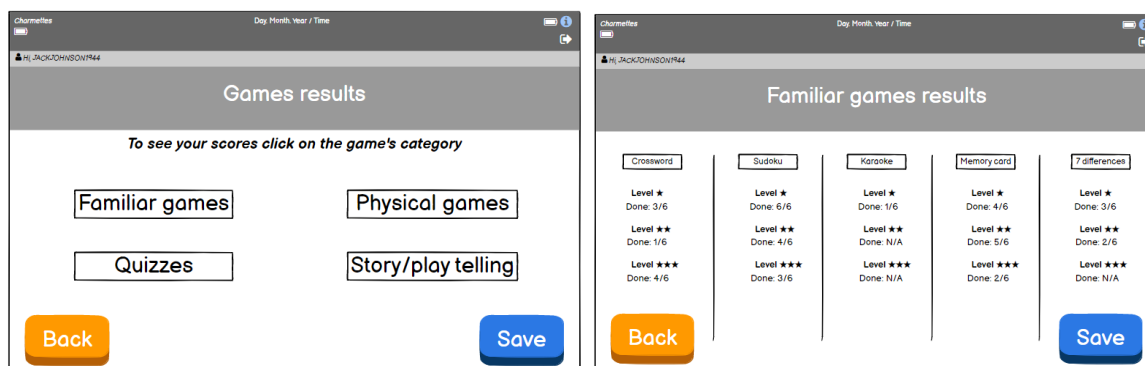


Figure 27: Cognition support

To understand on which level is the SMCI or to know what kind of exercises are the most complex for him/her to realise, a screen will appear with a ranking of all the games results. This screen will serve

to SMCI but also to carers who can have a glimpse of the effort made and compare it to observable results.

### 3.5.2 Coaching

The coaching screen will present to SMCI different ways to be coached regarding two different things: their use of the system and their game play. The screen will then purpose the SMCI few different ways to onboard on the system but also different ways to be supported and coached.

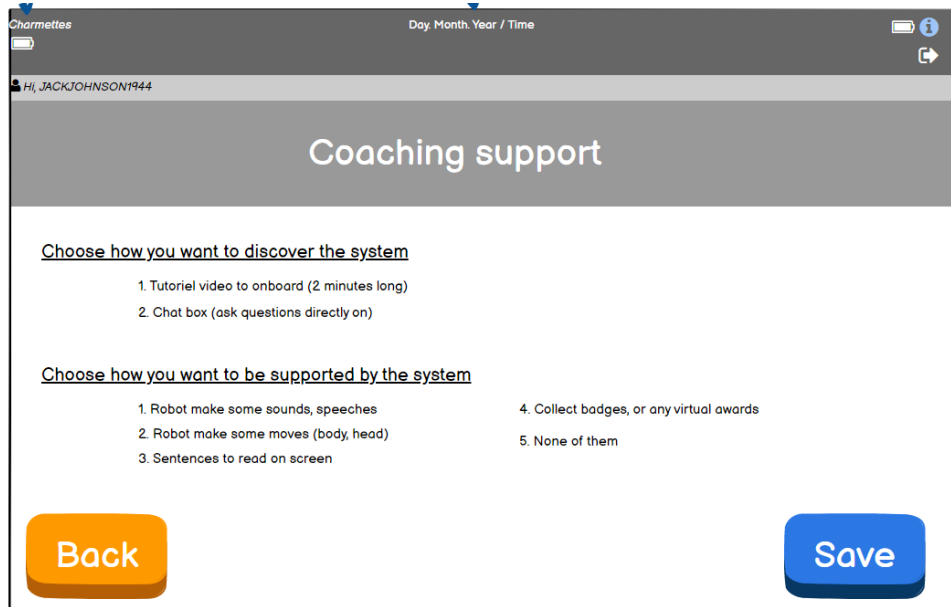


Figure 28: Coaching supports

## 4 Heuristic Evaluation

This section will gather and summarize all information needed regarding the involvement of end-users taking part into engAGE system quality and impact evaluation. Before starting tests such as Lab testing and field trial, a heuristic evaluation is required to anticipate use problems and to improve the prototype that will be presented on the following steps. Furthermore, the experts' vision and opinion on the project, either in general or on some specific points, is a plus for the progress of engAGE.

First, let's briefly recall all the steps that require participant recruitment to better situate and understand at which step, the heuristic evaluation, and the usability testing.

### 4.1 Participants criteria

UX design expert inclusion:

- Have a diploma on UX
- At least 1 years of work experience
- Not involved in engAGE
- Good written and oral comprehension of the English language

### 4.2 User Involvement

Table 4. User involvement for heuristic evaluation

Step	Deadline	Norway	Switzerland	Italy	Total
Heuristic Evaluation (HE)	M15 (February 2023)	1-2 UX design experts	1-2 UX design experts	1-2 UX design experts	<b>3-6 experts</b>

### 4.3 Channels of recruitment

The experts will be recruited among the partners' acquaintances. They may be colleagues or partners not involved in this project.

### 4.4 Heuristic evaluation methodology

The experts will have to navigate through the different screens of the services and report any problem they find on the screen.

Carrying out those tasks, experts will progressively detect usability problems that might arise to the end-users and will classify them in the table created specifically for the heuristic evaluation. This table aims to rank all use-related problems encountered in the testing of both services. Bastien & Scapin's heuristics will quantify the problems in terms of numbers. An indication of quality has always some benefits, that's why, to determine and rate the importance of the problems underlined by all experts, the Nielsen's gravity scale will be also set up on the heuristics table.

It is therefore through these two means that experts will classify the identified problems and suggest improvements to solve them.

It will be sent by mail to the experts with a short explanation of the purpose of the engAGE project and of each app, in attachment we will add the screens as well as an evaluation grid to complete and the heuristics. The expert will have to look at each screen for identifying issues and verifying that Bastien and Scapin and Nielsen’s heuristics are met (or not). The expert will indicate all the problems encountered in the evaluation grid and will have to return this grid by email to the partner.

#### 4.4.1 Evaluation grid

On this grid, the expert will indicate: the problem identified, its description, the heuristic and the associated principle, the priority, and his recommendation for dealing with the problem.

Table 5. Evaluation grid with a fictive example of problem identified

N°	Problem identified	description	Heuristic and associated criteria	Nielsen severity ranking	recommendation
1	help icon	The help icon is supposed to give instructions for each field, but it only repeats the name of the field, without any additional help	Nielsen: help users	3	Provide more detailed information on the expected response format.

#### 4.4.2 Bastien & Scapin’s heuristics

The 8 heuristic principles from Bastien & Scapin, listed below, are essential when making user interfaces UI evaluations. All UI need to be tested on *the guidance, the workload, the explicit control, the adaptability, the error management, the consistency, the significance of codes* and on *the compatibility*; to determine the satisfaction’s level of the product built so far. These criteria will allow a first scan of possible problems that may arise during use. Once these have been resolved, the basis for further evaluation will be more solid, leaving room for further measures.

To offer a wider appreciation of the criteria of Bastien and Scapin, here are some brief descriptions:

##### Guidance

The first Bastien & Scapin’s criterion to meet is the guidance which serves to evaluate all the various means deployed to advise, orient, inform and guide all kind of users throughout their interactions with an interface. This item is divided into four categories, such as: (a) prompting, (b) grouping/distinction of item, (c) immediate feedback and (d) legibility.

##### Workload

Workload’s criterion concerns all the elements of an interface playing a role in the load reduction (perceptual or cognitive) of the users, and in the increase of the dialogue efficiency. Workload will be analysed based on two sub-criteria: (e) information density and brevity regarding to (f) concision and minimal actions.



### Explicit control

Analysing explicit control is also essential. To do so, we must provide references on the system processing of (g) explicit user actions, and (h) type of control that users have on the processing of their actions by the system.

### Adaptability

The user interface must be adaptable to the person in use of it. The adaptability criterion refers has then to be checked on to estimate if the capacity to behave contextually and accordingly to the users' needs and preferences is currently possible or not. This time two points of analysis are proposed: (l) the flexibility and (j)the user experience.

### Error management

Refers to the means available to prevent or reduce errors and to recover from them when they occur. Errors are defined in this context as invalid data entry, invalid format for data entry, etc. For this purpose, three streams are available in case of need: (k) the error protection, (l) the quality of error messages and (m) the error correction.

### Consistency

The consistency criterion refers on the interface design choices (codes, naming, formats, procedures) that have been implemented. The aim here is to see if (n) the homogeneity is respected and to check the interface according to (o) the contexts (must be able to accommodate if used in different circumstances). The design of the information must remain consistent from one channel to another.

### Significance of codes

Significance of codes concerns the adequacy between the object or information displayed or entered, and its referent. Codes are significant to the users when there is a strong semantic relationship between the codes and the items they refer to. In order to do this, we must ask ourselves if (p) the interface language is adapted to the user's language and check is (q) the abbreviation rules are explicit.

### Compatibility

The criterion concerns the coherence between environments and between applications. It refers to the match between users' characteristics (memory, perceptions, customs, skills, age, expectations, etc.) and task characteristics on the one hand, and the organization of the output, input and dialogue for a given application, on the other hand.

#### 4.4.3 Nielsen's heuristics

Table 6. Nielsen's heuristics

Heuristic	Description
1. Visibility of the system status	The system must always inform the user about what is happening, using appropriate feedback.
2. Correspondence between the system and the real world	The system must speak the same language as the user, using familiar words and concepts and following real-world conventions.

3. User control and freedom	In case of an error, the user must be able to return to a state of the system prior to his action
4. Consistency and standards	The system must follow the conventions of the platform on which it is installed, to avoid the user wondering whether words, situations or actions all have the same meaning.
5. Error prevention	The system must prevent errors that could be made by the user and give him/her all the necessary information to avoid them.
6. Recognition rather than recall	Reduce the user's memory load as much as possible, by limiting the information to be remembered from one dialog box to another.
7. Flexibility and efficiency of use	The system should provide shortcuts for experienced users and offer the possibility to customize frequent actions
8. Aesthetics and minimalism	Dialogs should contain only essential and relevant information.
9. Help users recognize, diagnose and recover from errors	Messages should clearly explain the cause of errors and offer a constructive solution.
10. Help and documentation	Users should not need help. However, the information should be easy to find and correspond to the user's tasks for step-by-step help.

#### 4.4.4 Nielsen's Gravity scale

The Nielsen's Gravity scale will be useful for experts' review because it will simplify the ranking of all the use related problems detected that will be classified into priorities. If the score is 0, there is no usability problem; if the score is 1, there is just a cosmetic problem easily to fix; score 2 means that a minor usability problem has been detected which fixing is on a low priority; score 3 means that a major usability problem has emerged and has a high fixing priority. If the score reaches 4, there is a usability catastrophe that will be needed to be fixed before the releasing otherwise the use of the product is highly questionable.

## 5 Conclusions

The second version of the user experience and design deliverable present the updated mock-ups and dashboards that will be presented to UX-design experts who will evaluate the content of the interfaces and the layout of different elements such as: buttons, profile information, question display, relay time between on-screen display and voice command. Experts will provide recommendations to bring adjustments and better meet SMCI's characteristics. They will provide some adding if some aspects have been neglected.

Once the short heuristic evaluation and the improvements are done, the whole set of screens that will be improved accordingly. They will be then used for evaluation with end-users. End-users that will give their impression and proceed to an evaluation prompted by a moderator and a questionnaire.

The two rounds of evaluation will be implemented to gain on design quality and gather from the start different expectations and advice to build a pleasant interface with screens visually appealing and quality content. The improvements brought by experts and end-users on the solution will serve as a basis for the services of the next versions of the engAGE prototype.