



engAGE

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

D2.3 User experience design



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Contributing authors:	ALL
Peer-reviewers:	Amabili, G. (INRCA), Grimstad, T. (KRD)
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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 emerges from the first meetings and interviews held with the end-users. Through them, moderators from Switzerland, Italy and Norway have gathered needs, challenges and expectations, which have been then transformed into technical requirements. The screens and interfaces that are provided in this deliverable indicates how the requirements will be involved in some interfaces such as screens from Pepper's tablet or screens from MEMAS' application on smartphone.

To illustrate those requirements, some mock-ups of the engAGE solution, have emerged. Those mock-ups are the basis for our design reflections and the starting point for the end-users' evaluation. The aim of this deliverable is to provide a first draft 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.

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 mock-ups presented in this deliverable will then be 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 chapter, all mock-ups of tasks T2.3 will be presented and explained by the project partners. Some screens, like the welcome board on Pepper's tablet have been created (HUG), while some have been borrowed to existing components, like the basic screens from Pepper robot (IRIS), from the application MEMAS (KRD) and the mobile application gateway (TLU).

Before presenting the screens a short reminder on the Target group will be done to also support the decisions that had been taken in relation and a requirement summary will help to better figure out how the system is evolving.

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. The 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 IRIS on how to develop and integrate the requirements wanted on the robot's system.

1.3 Document overview

The Deliverable D2.3 is organised as follows:

- Section 2 presents the target group for whom mock-ups were created
- Section 3 presents the summary of the requirements established for the mock-ups
- Section 4 presents the whole set of mock-ups (screens from Pepper's tablet, from the mobile application gateway and the MEMAS application)
- Section 5 concludes the deliverable.

2 Target group

The engAGE solution has been designed to help seniors who are facing memory disorders and who would like to train their cognition to maintain a stable condition. Elderly population with mild cognitive impairments is then our primary target group. To take them into account, the study has also to focus on their surroundings, which can be composed of carers, either formal or informal. In a more distant way but still taking care of it, day care institutions will be considered among our target audience, as we want to install the engAGE system at some of them.

Primary

- Older adults with MCI (assessed by a healthcare organization or the formal caregiver), living independently and / or supported by caregivers, male or female, over 65 years, needing care assistance to self-manage and support their cognitive function, having a good comprehension of written and spoken local language, willing to participate to the interviews by signing the informed consent form.

Secondary

- Informal caregivers:
 - Family caregivers or any relative supporting the older adult with MCI, who helping regularly a SMCI for more than 6 months, have good comprehension of written and spoken local language, are willing to participate to the interviews by signing the informed consent form.
- Formal caregivers:
 - Professional caregivers such as doctors, nurses, healthcare assistants. Must be over 18 years old, to be involved in SMCI care of elders, to have at least one year of experience, to have a good comprehension of written and spoken local language, to be willing to participate to the interviews by signing the informed consent form.

Tertiary

- Healthcare organizations:
 - Day care centres for seniors dealing with elderly with MCI which would be interested by having a technological tool to work with.

3 Requirements summary

According to deliverables D2.1 and D2.2, the 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's 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 pushed 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's 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.

4 Mock-ups of engAGE system

The mock-ups listed in this chapter have been created after two important tasks. The first one is the task T2.1 in which end-users' partners (HUG, KR, and INRCA) had meetings with seniors with mild cognitive impairment and their carers, both informal and formal. 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 KR) 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 creation of the mock-ups presented have been done in parallel to T2.2. At each decision of technical partners, the mock-ups are adapted. T2.3 has been done to be complementary and developed over time. These mock-ups have all been created by IRIS partners.

4.1 Screens of Pepper's tablet

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.

4.1.1 Introduction

Logo presentation of the project, short description of the aims of the engAGE system.

4.1.2 First communication

The Pepper robot must be able to start an interaction or to understand when an SMCI wants to interact with it (Figure 1). 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.

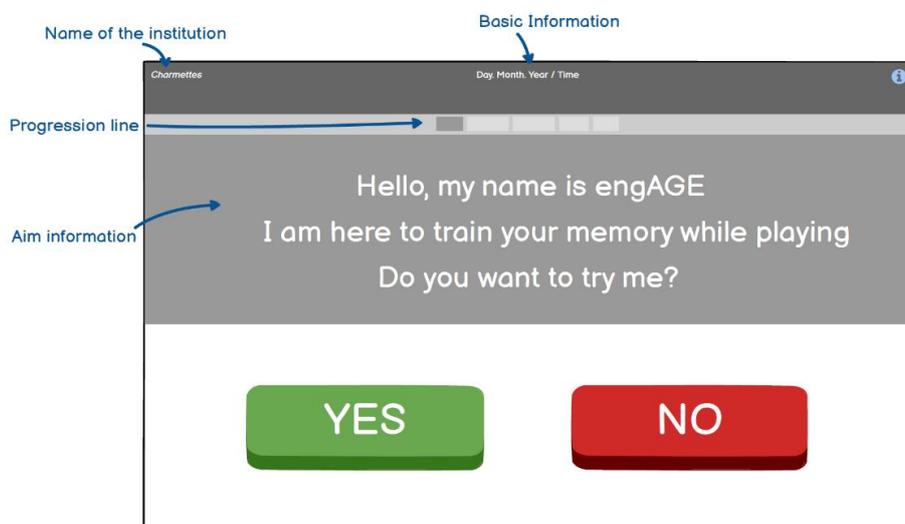


Figure 1: Screen of presentation

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.

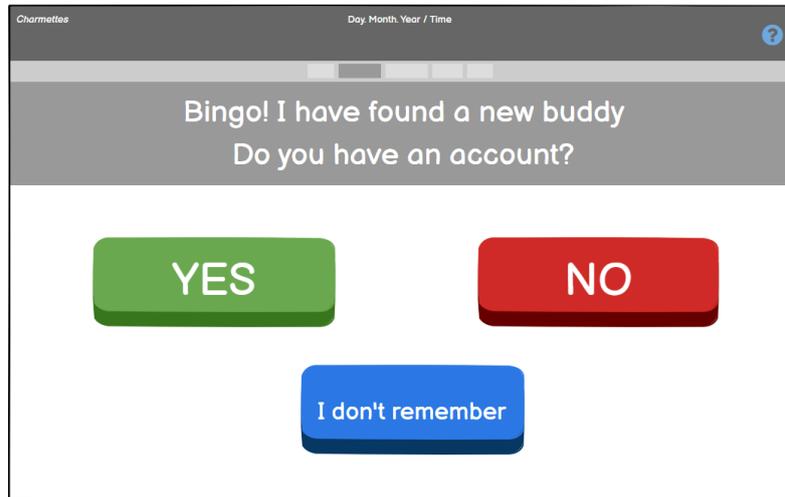


Figure 2: Follow-up screen asking for existing account

4.1.3 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.

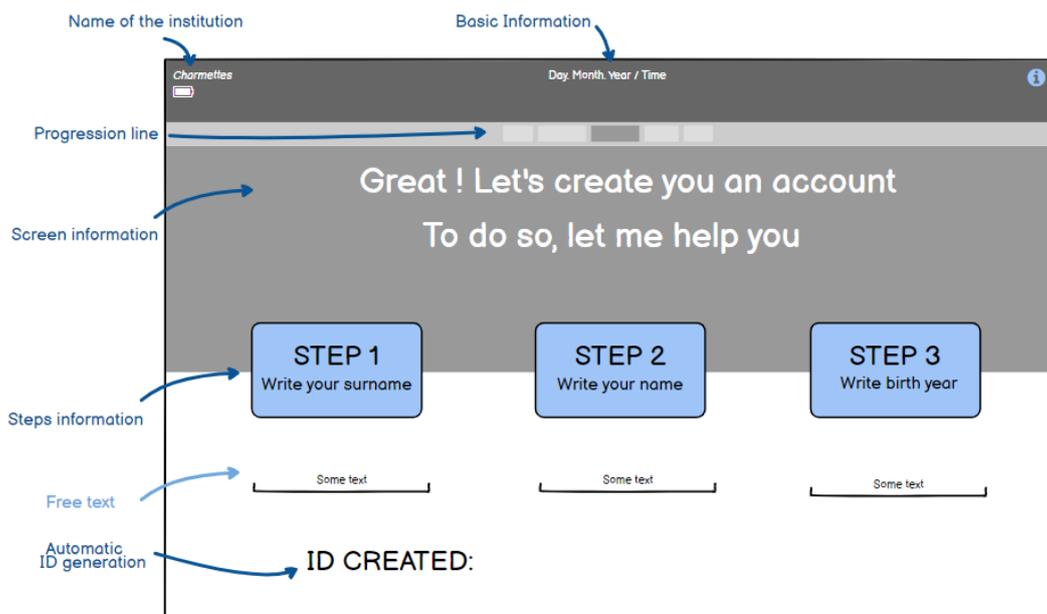


Figure 3: Help to create an easy to remember and secure ID

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*.

4.1.4 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.

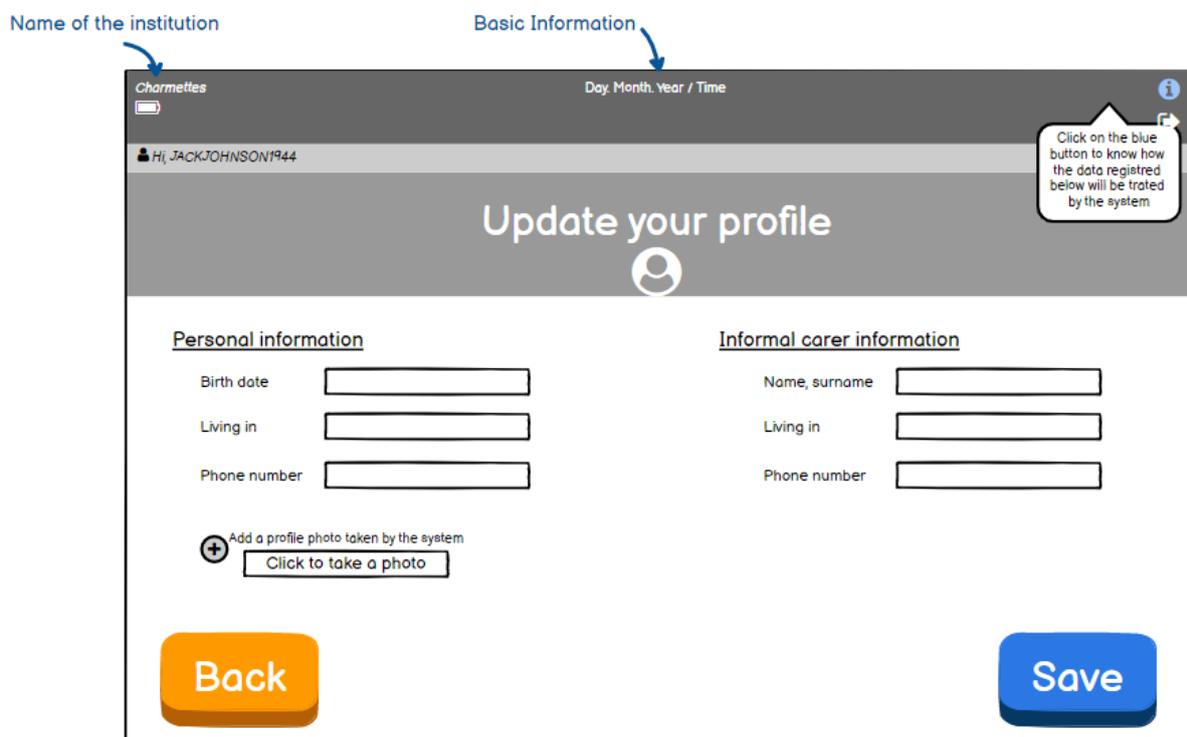


Figure 4: Profile screen

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.

4.1.5 Game’s menu

Once the account is created, the profile completed, the engAGE user will arrive on the game's 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.

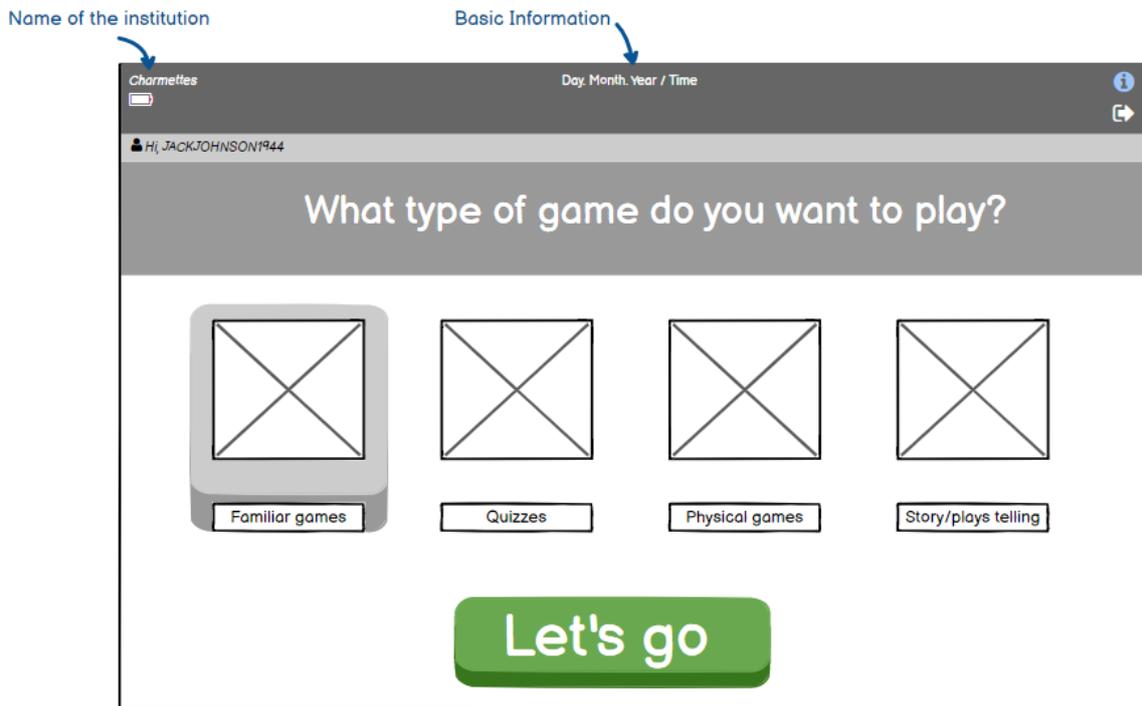


Figure 5: Menu screen

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.

4.1.6 Selected 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.

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.

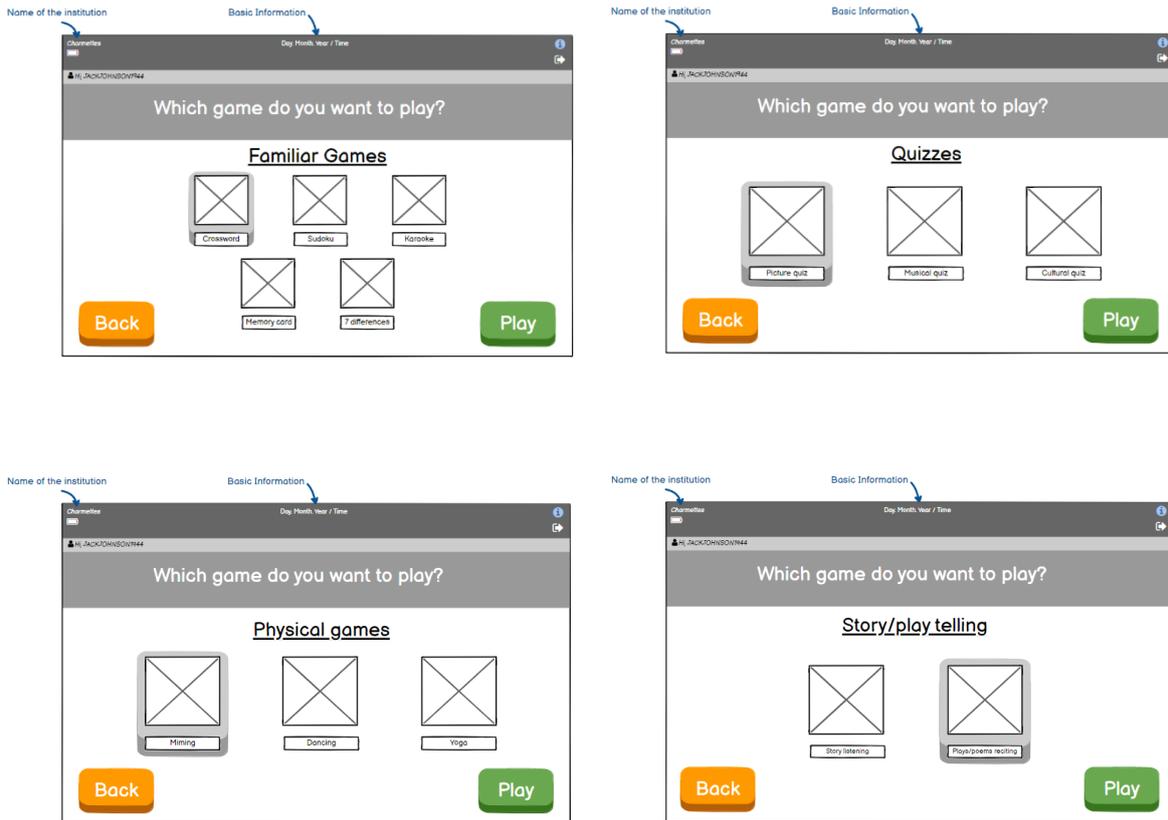


Figure 6: Screens of the selected game

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.

4.1.7 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.

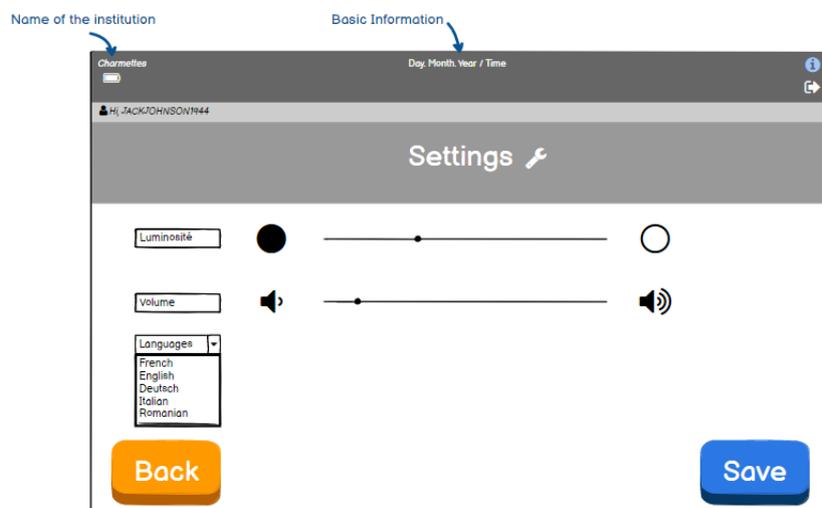


Figure 7: Screen of the settings

4.2 Mobile application gateway

The Monitoring, Self-Reporting and Big Data Processing service has little user interaction outside of the use of sensor devices. According to the architecture presented in D2.2, the service will feature a mobile application gateway which transfers data from sensor devices and into the cloud (see D2.2 Section 4.1.1). In the first iteration, it will transfer Fitbit data from the Fitbit service. It should do so automatically while running in the background on the mobile device of the primary user. There will be 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 mobile app may be extended with more functionality in later iterations.

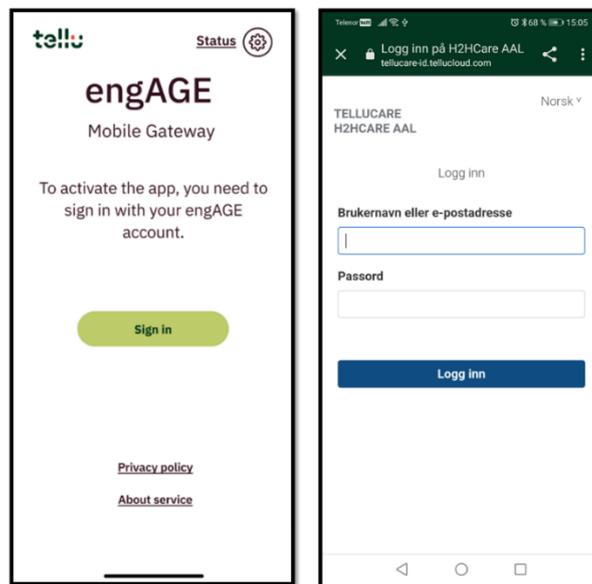


Figure 8: Signing on the Mobile Gateway and logging

We have sketched a user interface for the mobile application gateway using elements of TLU’s current mobile app design system. Firstly, we have an initial landing page, shown when the app is launched without a stored session. This is on the left side of Figure 8. The primary feature is the button to launch the user authentication. An example of an actual user authentication screen is shown on the right side of the figure. Here it is important to note that the authentication itself is not part of the application interface. For security reasons, the user authentication must be done in the web interface of an authentication service. This is handled by TLU’s ID broker, which can either use its own web interface or redirect to some other identity provider, such as Google. The identity provider could use two-factor authentication. The web view is shown on top of the engAGE app, and once done the user is returned to the app, which will then either proceed to the main screen or show an error if authentication failed. The landing page could also have links to information about the service, such as a privacy policy (these are also web pages), as well as a status page (described below). Once signed in, the user will stay signed in until explicitly signing out or the authorization service decides the session has expired, so the user will not normally need to sign in again.

On the left of Figure 9 we have the main screen of the application, with the main status and on/off switch. This is where we go once, we are signed in, and this is the first screen shown when opening the app if the user is already signed in. We want to show the name of the signed-in user and key status

information regarding the Fitbit data transfer. The Fitbit status field is colour-coded green/yellow/red, but any issue/error is also communicated with text. If there is an error with the Fitbit functionality, we may also want to include some troubleshooting information adapted to the error. Since the application is active in the background when enabled, regularly transferring data from the Fitbit service, there needs to be a switch to turn it on and off.

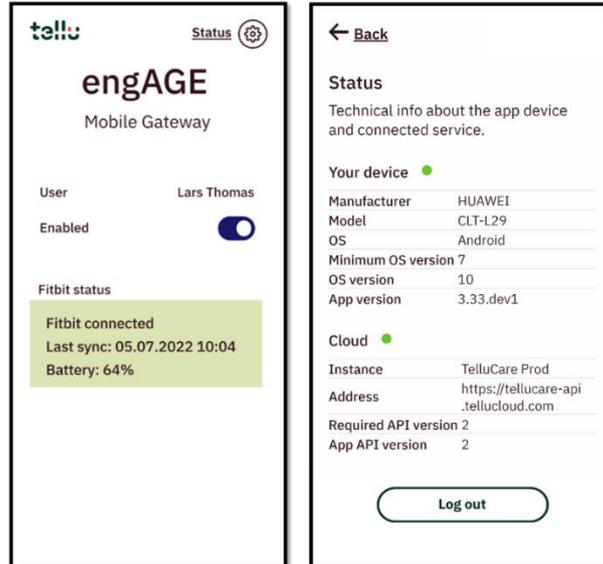


Figure 9: Mobile gateway main and status screens

We want to keep the main page clean and simple, to avoid any confusion and information overload. Information and functions which are seldom needed are instead placed on a separate status screen, shown on the right side of Figure 9. This status screen is available from the top right of the landing and main pages. Here we will show information about the mobile device and the connected service, which is essential information if the user needs to report a bug. If signed in, the option to sign out will be found here. When signed in there will also be a section for the Fitbit function, with buttons to test the Fitbit data transfer and to disconnect from the Fitbit service.

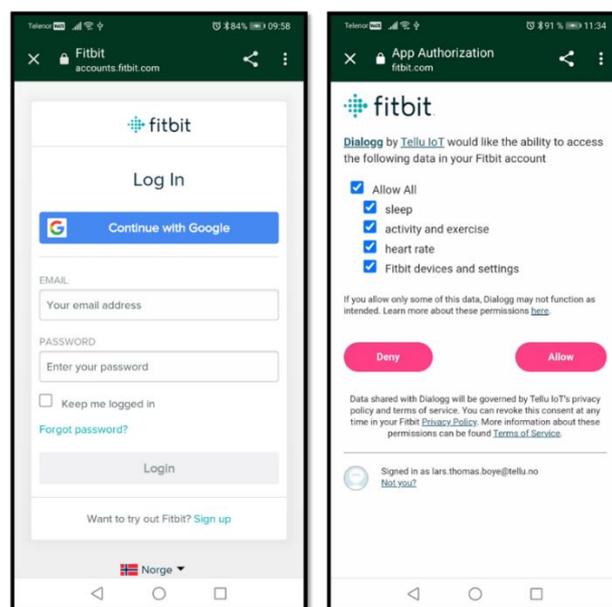


Figure 10: Fitbit authorization screens

The first time a user signs in, the app is not yet connected to the Fitbit service. When the Fitbit status is unconnected, the main screen will have a button for connecting to the Fitbit service. Pressing this launches the Fitbit authorization, shown in Figure 10. Just like the TelluCare authentication, this is done in an external web view, not in the user interface of our app. The user interface shown in Figure 10 is that of the Fitbit service. First, the user will need to log in to their Fitbit account. The Fitbit service will then tell the user what data our app is requesting access to, and the user can choose to accept or deny access to each type of data, using check boxes. Once done, the web view is closed, returning the user to the main app view, which will now show the updated Fitbit status. The app stores and refreshes the Fitbit authorization, so that it should not be necessary to authorize Fitbit access again.

4.3 MEMAS system

The MEMAS system 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. MEMAS is now undergoing a modernization, and the HCI in engAGE will be different, though the content will fairly much be the same.

4.3.1 The MEMAS 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.

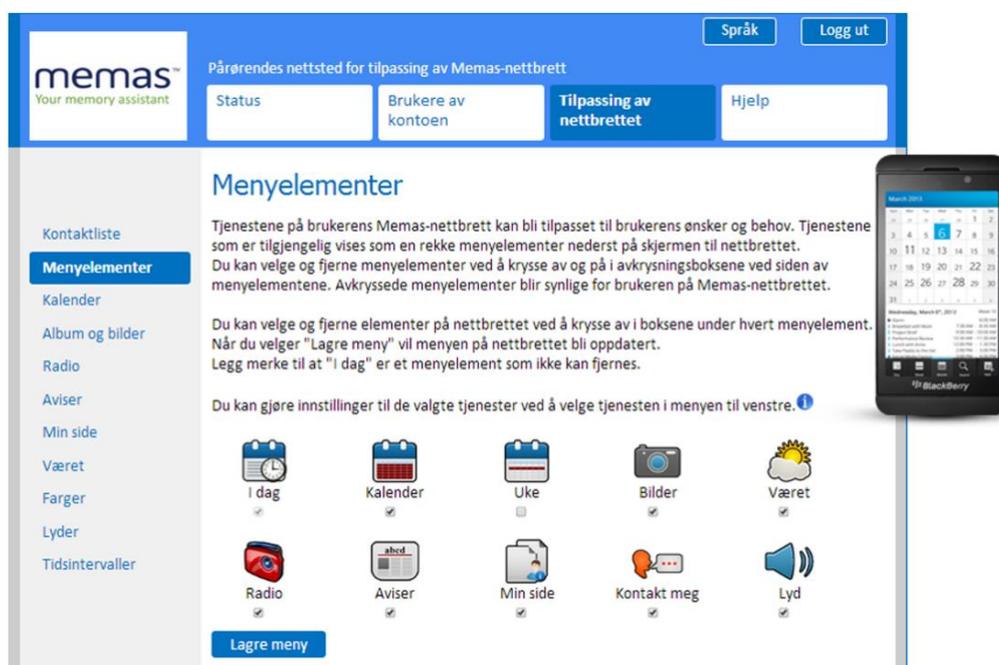


Figure 11: Main screen of MEMAS application

Figure 11 shows that you can select which elements from the MEMAS system which should be available for the primary user:

- Select which calendar views which will be available for the user (day, week, month)
- Select if you should show the album (Bilder), weather forecast (Været), radio, newspapers (Aviser), My page which may contain special information of interest for the primary user (Mine sider), Contact me, Sound (Lyd)

4.3.2 The MEMAS client, the tablet application

On the dashboard of primary user's tablet, they will have the possibility to click on the features they choose to use (all buttons below) and the information displays on the left side of the tablet. Figure 12 shows the planning for the day, which has been entered into the system by carers and relatives from the Adminweb. It also indicates the time and that it is morning. Here the time is shown with an analogue clock, it is also possible in Adminweb to select a digital clock or both. Passed actions will be turned into white/grey to inform SMCI that it's no longer relevant.

This is the home page of the MEMAS client. It will always show the calendar of today. 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.

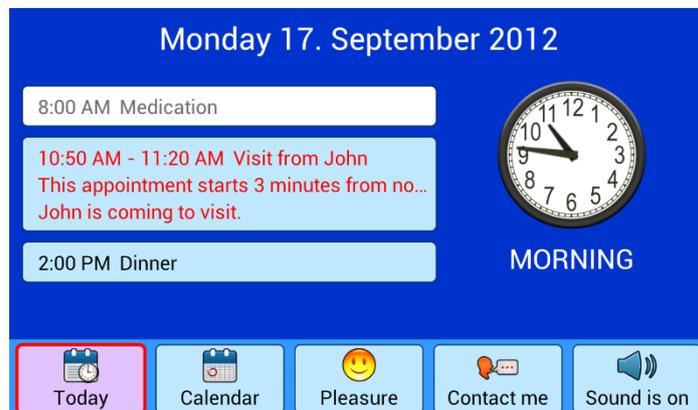


Figure 12: Reminder of today's appointments

Sometimes when clicking on a feature, the dashboard will disappear to let more space and gain visibility. The Calendar feature is one of them (see Figure 13). SMCI will have an easy vision on the whole month they are in and easy buttons to click on and scroll through the months.



Figure 13: Calendar option on MEMAS

When clicking on a specific day, SMCI can have all the information entered for that day such as reminders and appointments set. Passed actions will be turned into white/grey to inform SMCI that it's no longer relevant.

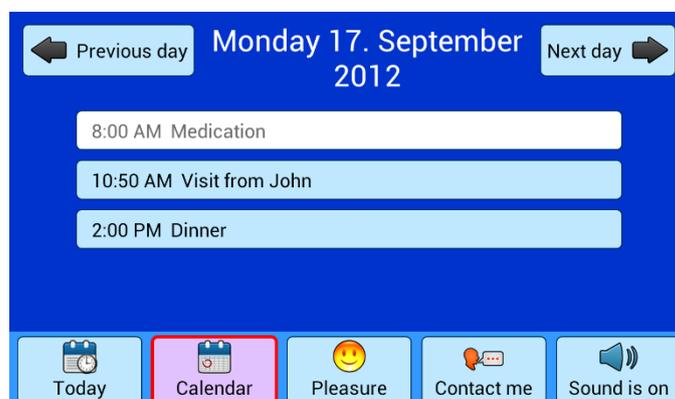


Figure 14: Setting an appointment on the calendar

If the primary user touches the Pleasure button, the following screen will be shown. In this case, the only pleasure function is albums.

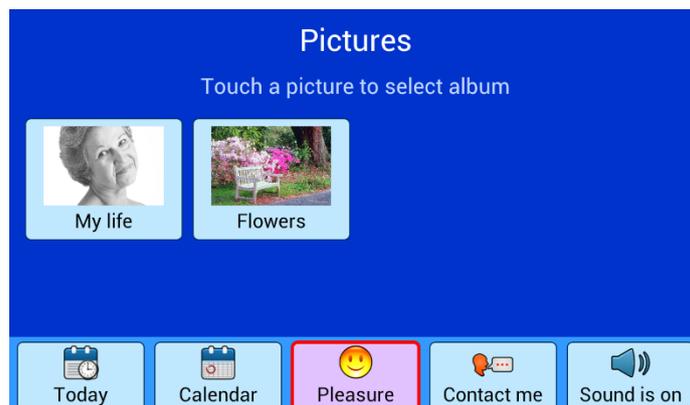


Figure 15: Picture library of MEMAS application

The primary user may choose one of the albums and scroll through the images in that album. It will be possible for the secondary user to enter a spoken comment or a story to the picture which could be played by the primary user. Alternatively write a text which could be spoken by synthetic voice.

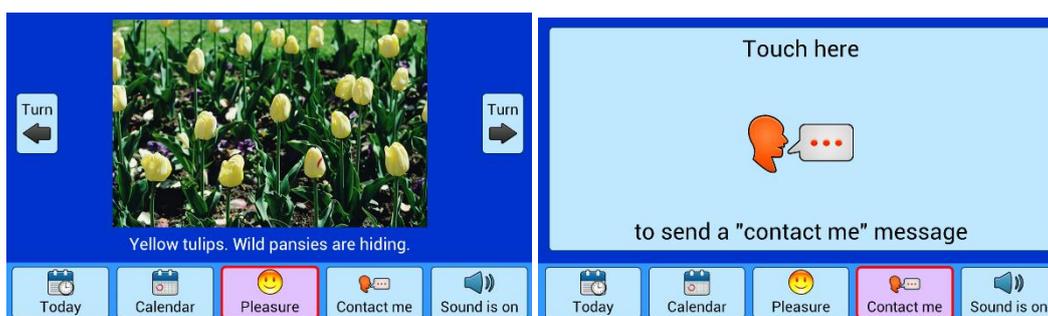


Figure 16: Contact option and message provider on MEMAS

If the primary user touches the Contact me button, the following screen is displayed. There are lots of other screens in the MEMAS client.

4.4 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.

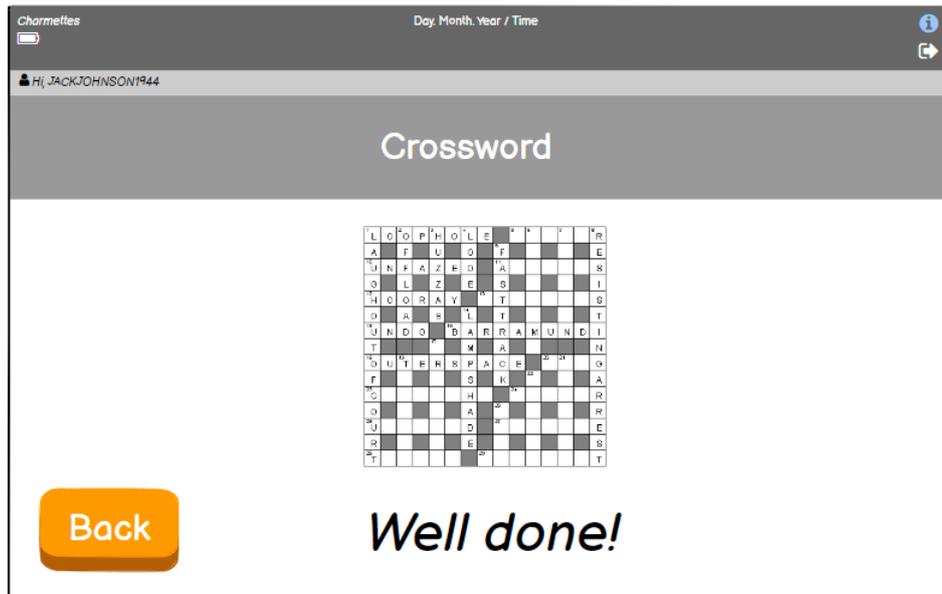


Figure 17: Robot's incentive

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.

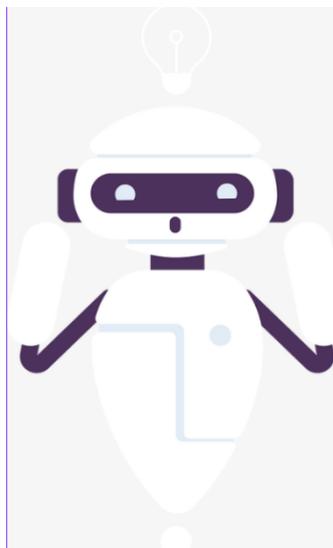


Figure 18: Robot making a sound or vibrating

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.

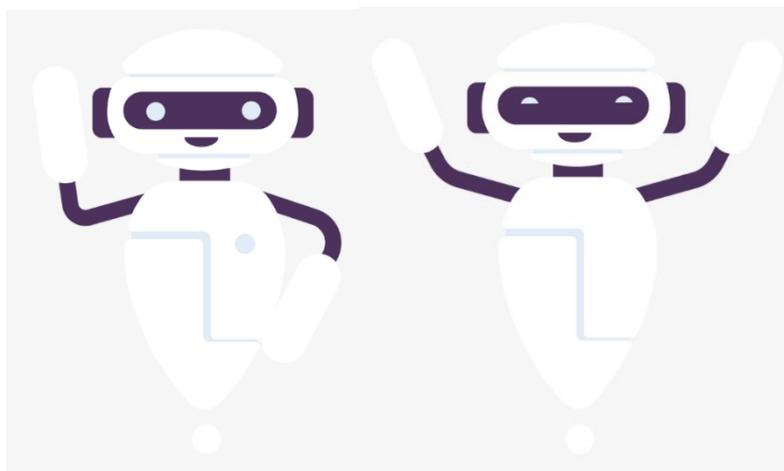


Figure 19: Body movement reactions

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

Table 1: Listing of sounds the robot could do

Greetings	Hey! How are you! Hello! Happy to see you!	Robot raises its arms, shake its hand. Robot moves to the SMCI.
Invitation to play	You want to play with me today?	Robot tilts its head.
Error's use	Oh no! Oopsie! Try again!	The robot vibrates to indicate that an error has occurred.
Success' use	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
Farewells	See you soon! Goodbye my friend! Bye! Take care!	Robot raises its arms, shake its hand. Robot moves to its base.

4.5 Types of support

4.5.1 Cognitive

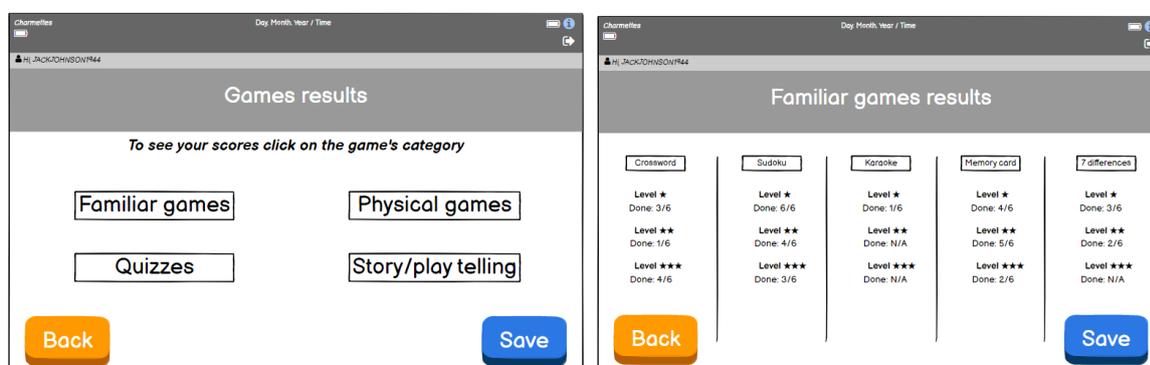


Figure 20: Cognition support

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.

4.5.2 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 propose the SMCI few different ways to onboard on the system but also different ways to be supported and coached.

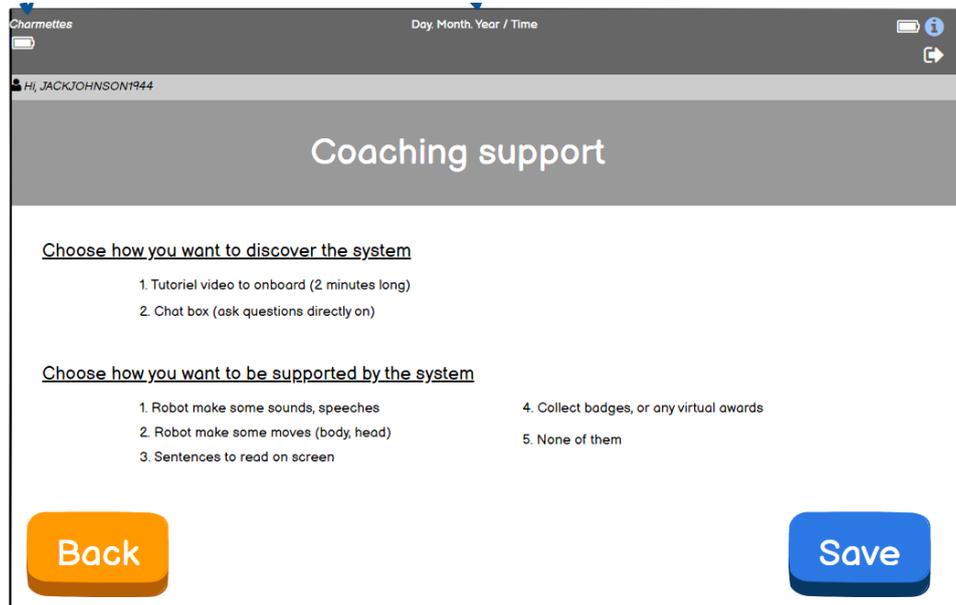


Figure 21: Coaching supports

5 Conclusions

These mock-ups will be firstly 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 recommendation i to bring some 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 displayed on the Pepper's tablet will be presented to primary and secondary end-users that will give their impression on it 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 thought so far will serve as a basis for the services of the first prototype of the engAGE solution.