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DELIVERABLE 1.3B DEFINITION OF USER INTERFACES AND SOCIAL COMPANION

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Disclaimer

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ABBREVIATION	FULL	DESCRIPTION
WP	Work Package	Category of tasks which details the description of work
IoT	Internet of things	inter-networking of devices which enable the collection and exchange data.

1 Introduction

Populations age which may introduce a shift in focus of target groups for the innovation market. In order for older people to live independently for longer in their houses we have to provide products to help them. It is only in this way that they can comfortably be self-sufficient and take care of themselves without the constant physical service of many caregivers.

Technology is the best way to tackle many different service possibilities. Ideally we want to create an autonomous system that provides services for all the needs of older adults. From health monitoring to social contact organization.

To reach this goal, we have to deal with some serious challenges.

Older adults often don't feel comfortable with technology as they did not grow up within this digital revolution. It is a completely new world they have to get used to. Despite advances in intuitive interfaces, technology remains a barrier for older adults to engage with contemporary services and social platforms.

Many older adults are quite independent and do not feel the need for technology in their homes, however, as technology becomes a central part of everyday life there is an ever-increasing demand for older adults to be able to engage with technology. In the past, there has been a stigma related to some products which are specifically designed for the older adults, Vizier aims to provide a solution that is both acceptable to users and delivers the vital components needed by the target group.

The limitations of vision, dexterity and memory is challenging the way to design an interface without stigma. We have to find smart ways to display information in a way that is easy and clear for older users and designed for everyone.

Vizier is gathering insights on the user needs of older adults living at home. With these insights in mind we will create concepts and prototypes of possible service use cases. The prototypes are used to validate a complete product system and this should be presented in a way that is easy to understand. These design guidelines will provide a checklist and inspiration tool for future interfaces to build upon.

Or as put in the Description of Work: "This task will design the intuitive user interfaces that will serve as the older adults-friendly interface for the users to access several components developed in WP2 through the end-user device. It will provide WP2 user-interfaces templates and guidelines. An important role will be dedicated to the social companion integration into the design. This includes on how the Vizier components will influence and if needed directly control the social companion through the home intelligence from their older adults friendly user interfaces."

2 Human Interface Design Strategy

2.1 Design For Our Future Selves

Vision, dexterity and memory begin to ebb long before 65. Designing for optimal readability and clickability will improve online experiences for those decades younger than retirement age, and do not need to be framed as “senior friendly.”

One thematic thread running through the pain points, is the stigmatization of old age, and by extension, stigmatization associated with technologies specifically designed for the old.

Seniors report avoiding technologies that would improve the quality of their lives — even enhance their safety — because they are associated with or specifically designed for the older adults. In our own research we also found that they consider help from an app as ‘outside’ help, which makes them less independent (ref. D1.1 User needs and functional requirements).

The paradox, then, for good UX design that addresses seniors’ needs is to do so without explicitly seeming to target the “old.”

“It’s paradoxical that the idea of living a long life appeals to everyone, but the idea of getting old doesn’t appeal to anyone.” — Andy Rooney

Product and UX design can influence the way people get old. When designing an interface we should imagine it to be for ourselves with the limitations of vision, dexterity and memory.

2.2 Design Principles

Inspired by the design guidelines by IOS apple[1] we have defined our own human interface design guidelines for design an interface for *our future selves*.

Three primary themes differentiate the “New-Old” interface from other platforms:

Essentialism. Focus on essential usability steps. Don’t overload the user with triggers that aren’t essential for that specific use step.

Silent Ushers. Help the user with hidden help functions. Fulfill the needs older adults have when using interfaces by secretly offering visual or auditory aids during the usage.

Limited depth. Distinct visual layers and realistic motion convey hierarchy, impart vitality, and facilitate understanding. Keep this depth minimal as older users often get lost in a complex hierarchical interface. Don’t expect the user to remember what s/he did the last time.

To maximize impact and reach, keep the following principles in mind as you imagine Vizier’s app identity.

3 Human Factors UI – Design For Older adults

3.1 Interaction influences

User interface interactions are always influenced by three sources :

- the user and their abilities
- the interface and its features
- the environment and its limitations.

3.1.1 User

Our main user is a male or female person from the age of 65 and older. Family, friends and professionals will communicate via the same platform which makes them secondary users with other needs.

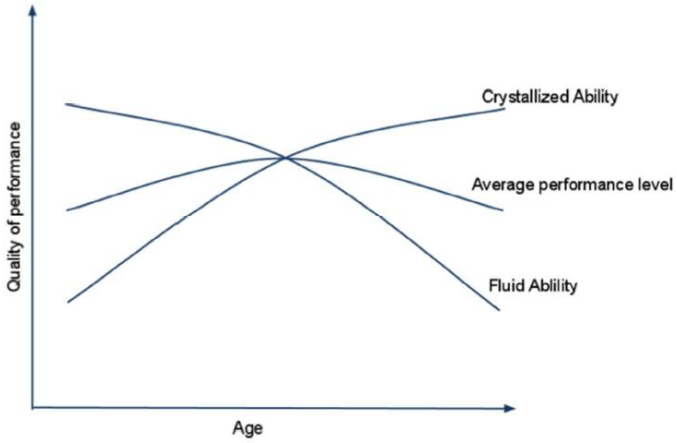
The user experience should be easy and fun for all users, without the sense that this is a technology created specifically for older adults that may be 'deficient' in any way. Hidden aids required for the older user will help him/her in times of difficulty without the secondary, more experienced users being aware.

Ergonomics, according to International Ergonomics Association, can be categorized into:

- Physical Ergonomics: is the knowledge that is built upon the limitations of human body including body sizes, movements, and senses of organs.
- Cognitive Ergonomics: is the knowledge that is built from human's mental related limitations. These include perception, memory, tension and mental workload.
- Organizational Ergonomics: is the knowledge that is built from the social interaction between human. Mostly, this aspect relates to the human when the activity or operation needs more than one people to complete.

Human memory has close relations to physical, cognitive, organizational ergonomics as they are the factors that support the tool/system usage or usability.

It appears that the older you get there is an evolution on your *fluid* and *crystallized* skills.



- Fluid intelligence = the capacity to reason and solve novel problems, independent of any knowledge from the past.

- Crystallized intelligence = the ability to use skills, knowledge, and experience.

As the app is a technology which is new to them, and the fluid intelligence is low, older adults need support when interacting with a new interface.

FIGURE 1 EFFECTS OF AGING ON HUMAN WORK PERFORMANCE(HORN, 1982)

15 of the most common diseases[2] above the age of 65 influence the usage with an interface :

- **Arthritis**
- Heart disease
- Cancer
- Respiratory diseases
- **Alzheimer's disease**
- **Osteoporosis**
- Diabetes
- Influenza and pneumonia
- Falls
- Substance abuse
- Obesity
- Depression
- Oral health
- Poverty
- Shingles

The impact of diseases impact the way users interact with a touch screen. Further research must clarify what the impact might be. This might influence the flexibility of our interface design.

3.1.2 Interface

From multiple sources (internal user research interviews and papers)[3] we can definitely conclude that the best interface for older people is the **tablet**. Compared to a computer the user can simply use his/her finger to directly select a function. A computer requires the coordination between screen and mouse. Compared to a smartphone, the tablet screen size is preferred mainly due to increased button sizes.

In fact, the touch screen technology is considered to be one of the most natural of all technologies[3].

What cannot be missed is the fact that the interface must adapt to different types of screens. If a user wants to check updates or notifications on the smartphone that interface should change the orientation towards the tablet version. The same for computer interfaces.

Other usability requirements must be a focus e.g., the minimal distance from which a display should be readable is 400mm[4].

For older adults with disabilities extra accessories can be developed where to help to interact with the screen. For example : tablet casing with handles for Parkinson's disease or magnifying glass on tablet for increased readability.

Gesture recognition is one of the most natural and intuitive ways of interacting, since it closely mimics how humans interact with each other. Introducing this technology in the interaction with an avatar, could change user behavior extensively and solve physical, social and health issues.

3.1.3 Environment

Daylight is not always present in an older adult's home. The screen of a tablet/computer should therefore adapt to the environmental light density.

Sun reflection is not ideal for a screen interface. A screen should always have an anti-glare coating.

When an older user is in a public environment it is stigmatizing for him/her to use for example the auditory aids on the interface.

3.2 Jobs to be done

We used this general list of jobs to be done by an application interface, to show a combination of design principles.

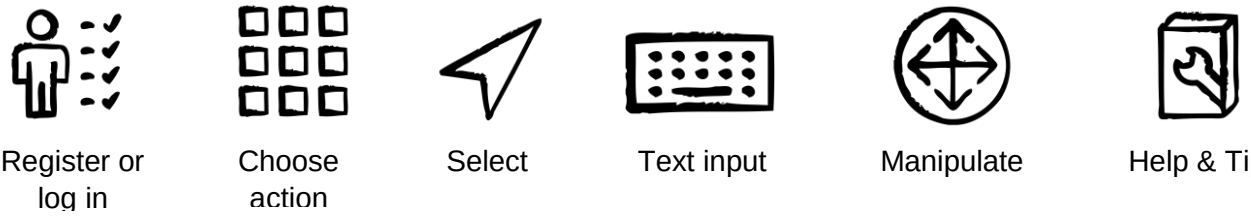


FIGURE 2 JOBS TO BE DONE - GENERAL INTERFACE

3.2.1 Register or Log in

3.2.1.1 Focus on one single input per screen

To register a user expects a very simple interface with short and self-explaining questions. If possible the tablet already has saved the register information inserted each time when a new app is installed. The user only needs to do the final check and press OK after checking the box of general conditions.

It is optimal if all information inputs are separated from each other so that the user can focus on 1 input box at a time.

For example
To call a doctor, you have to enter a few details like phone number and state, city and street name. All these information needed is asked in a separate screen. For that matter the user is not confused by other stimuli.

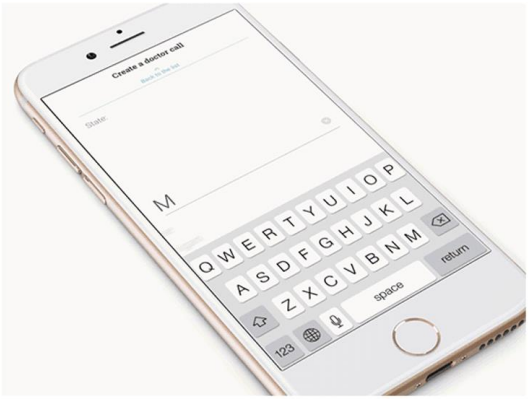
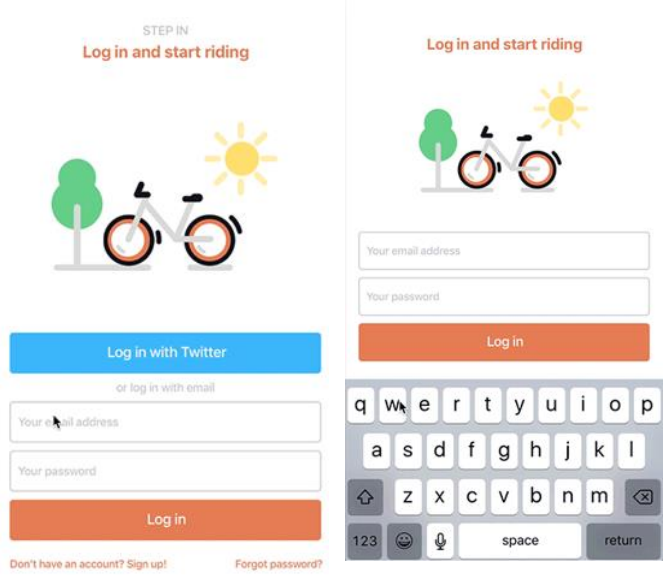


FIGURE 3 INTERFACE SCREEN 'CREATE A DOCTOR CALL'



3.2.1.2 Don't hide essential buttons

When the type keyboard appears for entering the information, make sure not to overlap any of the buttons shown on the previous screen.

Keep the lay out consistent and keep showing what has been shown before.

For example
Make sure the Log In button is always visible, also when the keyboard pops up

FIGURE 4 INTERFACE SCREEN 'LOG IN BUTTON'

3.2.2 Choose Action in Start page

3.2.2.1 Textual Clarification

It is important to show an icon that is always accompanied by a textual clarification[5]. It has been noticed that older adults often interpret icons in another way which may be confusing.

Instead of shown in Figure 5 we want to add the text above the icon, not below. In that way the user can select the button (icon) and still read what s/he has selected.

This might not be very important to secondary users so this function can be a variable setting selected in the preferences.

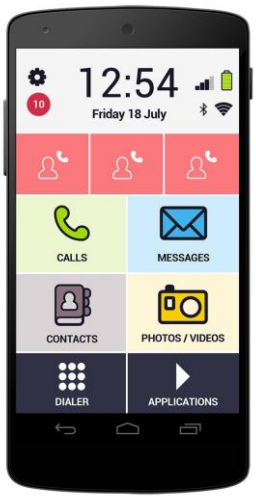


FIGURE 5 START PAGE

3.2.2.2 Contrast Icons

Icons for older adults are often designed to be visually more clear. For example by making the outline more thick (see Figure 5). But in order not to stigmatize we have to be subtle. A single-colored icon on a single-colored background with maximal contrast, has the same clear impact (see Figure 6).

FIGURE 6 CONTRAST ICONS

3.2.2.3 Main Menu Navigation

Always keep the main menu in the start page at the bottom of each page to easily navigate in the app (see Figure 7). It is important for older adults to be able to go a step 'back'[5].

Asking for confirmation is key when an action must be fulfilled.

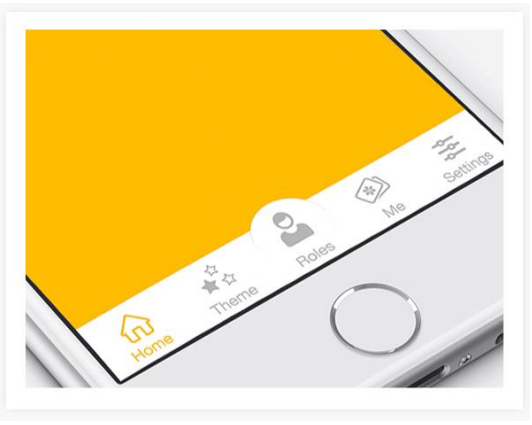


FIGURE 7 MENU BOTTOM PAGE

3.2.3 Select

Often older adults tap really hard on the touch screen because they don't understand the soft touch of a flat finger top is enough to select a button. Usually they tap with the top of their finger or nail. It might take two or more taps before the button is selected.

A combination of **tactile, visual and auditory** feedback is the best way to interact with older users[6].

3.2.3.1 Size of icons/buttons

The ideal size of icons is determined by a summary in literature[6]. Ideally older adults are well interacting with icons that have the dimensions of 12 mm height with a 0.9 mm width-height ratio. Pay attention not

to place any interaction button close to the edge of the screen as it will be difficult to select[5]. Also make sure to provide at least 44 pixels[7] of white space in between interface elements.

3.2.3.2 Hidden aids for tapability

Vision, dexterity and memory begin to ebb long before 65. Designing an interface that helps users with visual impairment is something we can't ignore.

Enlarging all buttons and letters is often not enough because many older adults don't look for better glasses for optimal readability. We suggest that a 'hidden aid' is provided where a long touch of a button provokes a **voice explanation** of the function of that button.

For example
An old man with vision problems wants to call the doctor but selects the wrong call button and ends up with his son. The son answers the phone and realizes his father has pushed the wrong button. 10 minutes later he gets the same call, again the same mistake. This can go on forever. What if the buttons give auxiliary feedback about its function for users with visibility issues?

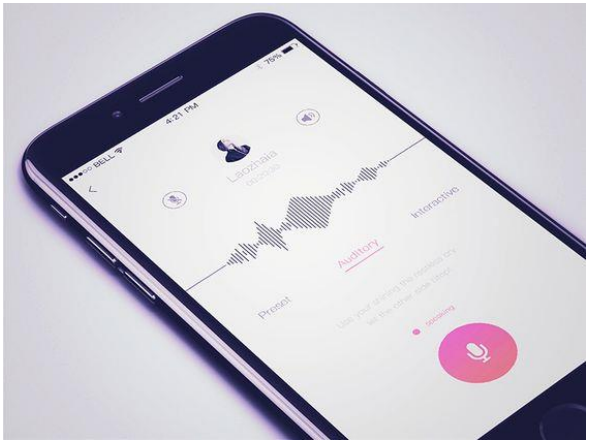


FIGURE 8 AUDITORY FEEDBACK 'HIDDEN AID'

3.2.4 Text Input

3.2.4.1 Typography

A general QWERTY keyboard is similar to all other text interfaces on smartphone/tablet which won't stigmatize older users.

In general **sans serif fonts** provide a good readability. Matching contrast is also important. Literature[8] states that a **light grey background with black letters** is perceived as best suitable contrast for older people. A white background is also good readable but the contrast might be too hard.

Avoid the color blue for important interface buttons. Color perception and sensitivity [changes with age]; less violet light is registered, making it easier to see red and yellows than blues and greens and often making darker blues and black indistinguishable.

3.2.4.2 Ideal size of keys

The ideal size of type keys are summarized from multiple research studies. Ideally a type key size should be 19x19 mm[6].

3.2.4.3 Predicting next character

It is important to focus on the essentials during this task. Suggesting predicted words appears helpful but it might require too much attention while they focus on typing. Designing for optimal readability we suggest to increase the size and change the color of the 4 most probable letters which are very likely to be entered next[9] (based on database of words and frequency of typed words by the user). As displayed in **Figure 9** (a) the Color variant appears to be the most helpful compared to the other options[3]. Preferably users like to see the key color changing to a more distinctive color than grey as this looks like the letter is not applicable.

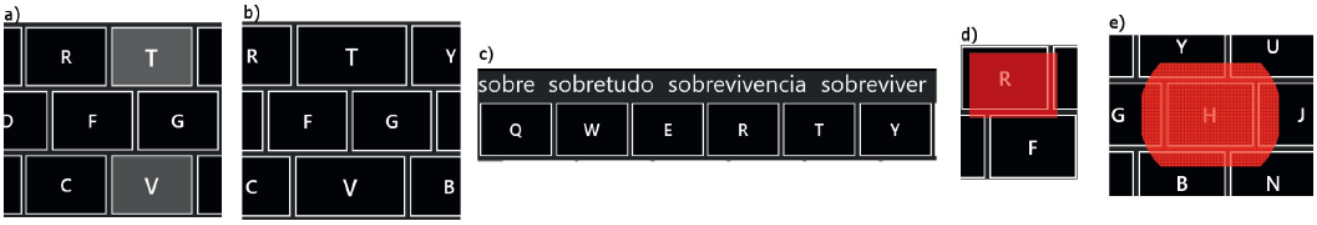


Fig. 1. (a) Color variant; (b) Width variant; (c) Predicted words variant; (d) Shifted variant; (e) Size invisible variant.

FIGURE 9 HIGHLIGHT PREDICTED CHARACTERS

Appearing to be the best combination is highlighting the key with a color.

3.2.5 Manipulate screen

Manipulating touch screens appears not to be easy. Older adult users can find it difficult to use multiple fingers across the screen. Actions like zoom in and out, scrolling with two fingers, rotation and dragging gestures. Multi-touch gestures should have button-based alternatives[6].

Our recommendation is to stick to interactions that only require 1 finger and differentiate manipulations with movement direction or longitude of pressing.

Another 'hidden aid' is a **magnifying glass** which can be provoked when holding the finger longer on the screen. The user can select the area which needs to enlarge and then a magnifying glass appears on the screen.

Focusing on part of an interface also facilitates interpretation of information. Other stimuli are blurred and don't influence reading part of the information.

Extra functions might appear with the magnifying glass which allows the user to operate in this zoomed view.

FIGURE 10 MAGNIFYING GLASS 'HIDDEN AID'

Try to limit the amount of clicks, swipes and enters before getting to a final action. The key rule we have to keep in mind is the maximum of 3 steps in which the user must get to his/her destination. Avoid interfaces that are layered too deep so that the user doesn't get lost in the hierarchy.

3.2.6 Help function & Tips

As the interaction with touch screens and interfaces in general is completely new to some users, the interfacing should be very intuitive to use. Nevertheless, older adults don't easily try new things because often they are afraid of the missing knowledge in technology.

3.2.6.1 Video guidance

We have to guide them when using the Vizier interface. A good way of doing this is by offering video guidance where other older adults perform the interaction on the touch screen. It encourages new users seeing someone from the same generation easily interacting with the screen.

3.2.6.2 Step by step

It is important to show an explanation for each use step without showing too much information. This only confuses people. Go through the usage step by step without causing discomfort or stigma.

For example (See Figure 11)
Samsung offers the packaging for a new smartphone as a book where the user can follow specific steps page by page.

It is important to have in mind is that we can't expect the older users to remember how they used the interface the last time. The guidance should be accessible at all times.

FIGURE 11 PACKAGING MANUAL SAMSUNG

4 Ergonomic guidelines for user-interface design

To conclude, the following points are guidelines for a clear user interface design. These are the must-have elements that need to be taken into account. Older adults have more issues with some of the design guidelines than the younger user groups. See the highlighted bullet points for the guidelines which are high priority for the Vizier system.

- Consistency ("Principle of least astonishment")
  - certain aspects of an interface should behave in consistent ways at all times for all screens
  - terminology should be consistent between screens
  - icons should be consistent between screens
  - colors should be consistent between screens of similar function
  - Keep the same positioning of interface elements and their respective operations
- Simplicity
  - Focus on essentials
  - break complex tasks into simpler tasks
  - break long sequences into separate steps
  - keep tasks easy by using icons, words etc.
  - use icons/objects that are familiar to the user
  - Minimal deep navigation (e.g. 3 actions to call someone)
- Human Memory Limitations
  - organize information into a small number of "chunks"
  - try to create short linear sequences of tasks
  - don't flash important information onto the screen for brief time periods
  - organize data fields to match user expectations, or to organize user input (e.g. autoformatting phone numbers)
  - provide cues/navigation aids for the user to know where they are in the software or at what stage they are in an operation
  - provide reminders, or warnings as appropriate
  - provide ongoing feedback on what is and/or just has happened
  - let users recognize rather than recall information
  - minimize working memory loads by limiting the length of sequences and quantity of information - avoid icon mania!

- A minimum of interferences on the screen and the latest should be very straightforward and short, so as not to overload the older adults's mental space and working memory abilities,

- Cognitive Directness
  - minimize mental transformations of information (e.g. using 'control+shift+esc+8' to indent a paragraph)
  - Focus the view on the current user action without displaying secondary actions or next steps
  - use meaningful icons/letters
  - use appropriate visual cues, such as direction arrows > suggest & highlight next steps
  - use 'real-world' metaphors whenever possible (e.g. desktop metaphor, folder metaphor, trash can metaphor etc.)
  - Automatic remembering of the often used words
  - Avoid creating multiple gestures that combine more than 1 finger and require more than 1 hand
- Feedback
  - provide informative feedback at the appropriate points
  - provide appropriate articulatory feedback - feedback that confirms the physical operation you just did (e.g. typed 'help' and 'help' appear on the screen). This includes all forms of feedback, such as auditory feedback (e.g. system beeps, mouse click, key clicks etc.)
  - provide appropriate semantic feedback - feedback that confirms the intention of an action (e.g. highlighting an item being chosen from a list)
  - provide appropriate status indicators to show the user the progress with a lengthy operation (e.g. the copy bar when copying files, an hour glass icon when a process is being executed etc.)
  - Multi-sensorial : visual, auditive (Voice-over assistance) and tactile (haptic)
- System messages
  - provide user-centered wording in messages (e.g. "there was a problem in copying the file to your disk" rather than "execution error 159")
  - avoid ambiguous messages (e.g. hit 'any' key to continue - there is no 'any' key and there's no need to hit a key, reword to say 'press the return key to continue)
  - avoid using threatening or alarming messages (e.g. fatal error, run aborted, kill job, catastrophic error)
  - use specific, constructive words in error messages (e.g. avoid general messages such as 'invalid entry' and use specifics such as 'please enter your name')
  - make the system 'take the blame' for errors (e.g. "illegal command" versus "unrecognized command")

- Explanation when asked (e.g. by tapping long on a button) as a secret key only known by them

- Anthropomorphization
  - don't anthropomorphize (i.e. don't attribute human characteristics to objects) - avoid the "Have a nice day" messages from your computer
- Modality
  - use modes cautiously - a mode is an interface state where what the user does has different actions than in other states (e.g. changing the shape of the cursor can indicate whether the user is in an editing mode or a browsing mode)
  - minimize preemptive modes, especially irreversible preemptive modes - a preemptive mode is one where the user must complete one task before proceeding to the next. In a preemptive mode other software functions are inaccessible (e.g. file save dialog boxes)
  - make user actions easily reversible - use 'undo' commands, but use these sparingly
  - allow escape routes from operations > Maintain a “return” button at all times
- Attention
  - use attention grabbing techniques cautiously (e.g. avoid overusing 'blinks' on web pages, flashing messages, 'you have mail', bold colors etc.) > Apply as little effects as possible when the subject of interaction is serious (<> games)
  - Best icon size 12x12 mm
  - Best type key size 19x19 mm or more (up to 30mm)
  - don't use more than 4 different font sizes per screen
  - use serif or sans serif fonts appropriately as the visual task situation demands
  - don't use all uppercase letters - use and uppercase/lowercase mix
  - don't overuse audio or video
  - use colors appropriately and make use of expectations (e.g. don't have an OK button colored red! use green for OK, yellow for 'caution, and red for 'danger' or 'stop')
  - High contrast (light grey with black letters)
  - don't use more than 4 different colors on a screen
  - don't use blue for text (hard to read), blue is a good background color
  - don't put red text on a blue background
  - use high contrast color combinations; use colors consistently
  - use only 2 levels of *intensity* on a single screen
  - Use *underlining, bold, inverse video* or other markers sparingly
  - on text screens don't use more than 3 fonts on a single screen
  - Closed caption for each icon/button

- Avoid pop-ups in front of important text or button

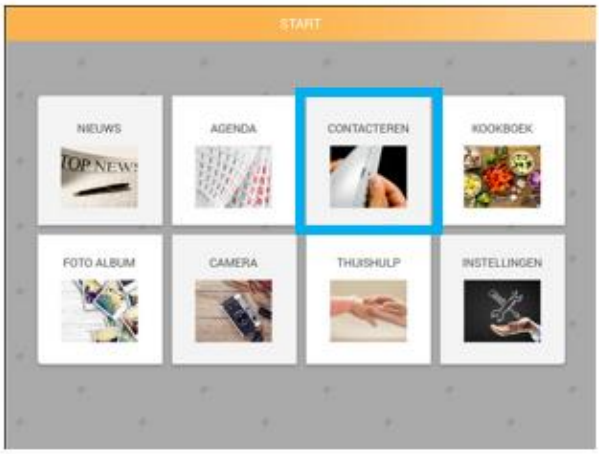
- Display issues
  - maintain display inertia - make sure the screen changes little from one screen to the next within a functional task situation
  - organize screen complexity
  - eliminate unnecessary information
  - use concise, unambiguous wording for instructions and messages
  - use easy to recognize icons
  - use a balanced screen layout - don't put too much information at the top of the screen - try to balance information in each screen quadrant
  - use plenty of 'white space' around text blocks - use at least 50% white space for text screens
  - Maintain minimum of 44 pixels between interface buttons
  - group information logically
  - structure the information rather than just presenting a narrative format (comprehension can be 40% faster for a structured format)
  - Time exposure increased of temporary posts and place them in the middle of the screen

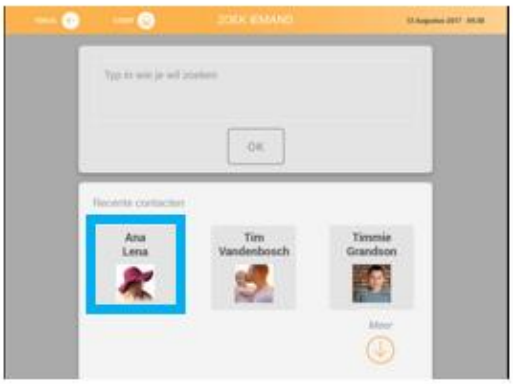
- Individual differences
  - accommodate individual differences in user experience (from the novice to the computer literate)
  - accommodate user preferences by allowing some degree of customization of screen layout, appearance, icons etc.
  - allow alternative forms for commands (e.g. key combinations through menu selections)
  - Automatic adaption of interface settings over time

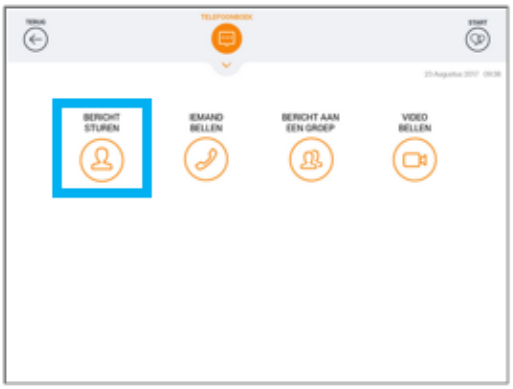
5 User-interface design and user feedback

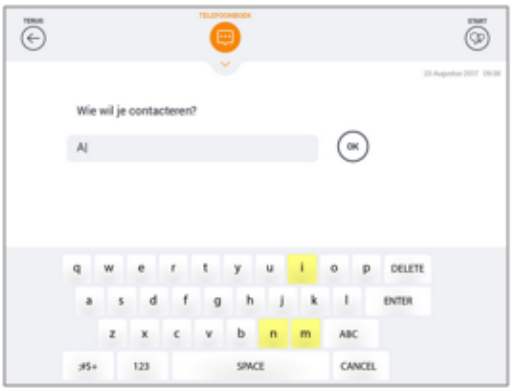
With the guidelines formulated above, we now start to create. We designed 3 diversified tablet interfaces for peer review in June 2017. The 2 selected options were optimized and translated to Dutch for testing with actual users and gathering their input.

On the left concept "tiles", on the right concept "one step".









We visited 6 potential end users in Belgium and asked them to use both options to send 'Ana Lena' a message. We observed them finding their way with the interface and asked them afterwards what they liked, disliked, what they would change, …

For the details, we refer to the annex[10]. Here are the main points of feedback. The score is the number of users preferring that part of the concept.

	CONCEPT "TILES"	SCORE	CONCEPT "ONE STEP"	SCORE
General look & feel		6/6		0/6
Photos or Pictos	Photos	6/6	Pictos	0/6
Start Logic	Search contact, then choose between the shown options (channels)	4/6	Choose the type of message / call first, then who	2/6
Input of contact	Type and use recent contacts	5/6	Type	1/6
Typing	Classic keyboard	4/6	Simple keyboard and color help indicating possible characters	2/6
History of messages	With selection key	2/6	Automatic function	2/6
Send photo	Without text	3/6	The user can add text	3/6

5.1 Conclusions

The **look and feel** of concept "Tiles" - with photos that depict functions - is clearly preferred and will serve as an example for the Vizier UI designs.

Some options had a clear preference for one (4-5/6) and on other there were differences of opinion (2-3/6). We will stick in our future designs to **confirmed preferences**, being:

- Contact or address book on the home page, which is the start point for all conversations (calls, messages, video calls, mails, …)

- Input to search a contact by typing and showing the recently used contacts as a button.

- We will use the normal tablet keyboard.

The topics with difference in preference, we will consider to implement as **an option or a setting**, so everyone can have their personalized version of Vizier. This could be the case for the display of the previous conversation in the massage and mail app. For those who want it, it's on. People who feel distracted by it, can turn it off.

The same goes for highlighting the most probable following keys on the keyboard and for adding a message to a photo message.

This work, involving the end user in the design process, will continue further all along the project. The next step is to involve users again in the planned pre-trial with the first working prototype and observe them interacting with the system, hear how they experience it and learn more about their preferences and ideas.

6 Social Companion Definition

6.1 Older adults and Social Companions

Studies shown that humans will not easily accept social companions that behave like all knowing superior beings and especially when these social companions cannot achieve what is expected from them due to the current technological limitations[10]. Cynthia Breazeal, who has been working on social robotics for the last two decades, has shown for example that social companions are more likely to be accepted by humans when they are modelled to show an infant similar behaviour[11].

Humans are more likely to allow a social companion supporting them if they can actively contribute in the development of its skills, having thus an influence / a choice of what type of care and to what level will be provided to them over time. This assumption is one of our motivators to have a social companion showing an 'infant-like' behaviour providing initially for a minimum set of essential support services. Over time, the social companion can adjust/enhance its skills and competencies in a human-like way through different types of learning.

6.2 Social Companion Operational model

Turning virtual humans and robots into believable, and thus acceptable, communication partners requires highly natural verbal and nonverbal behaviour. Based on the literature review we defined the psychological and behavioural model of the social companion:

- Recognition of speech/language input
- Generating clear and concise speech/language output
- Following human dialogue conventions
- Understanding user turns
- Generating output containing relevant information
- Generating output containing task related information

This served as the basis for the definition of the operational model, which describes the social companion as an interactive character processes and generates verbal input / output to engage in human-like communication with the older adult.

The social companion has the ability to interpret and respond to verbal (e.g., spoken language) and non-verbal input (e.g. facial expressions) by producing appropriate communicative responses. The user's affective state can be recognized through dialogue. Additionally, the social companion may infer the user's state based on knowledge of the user's movements. The social companion has the ability to express emotional behaviours that may influence the user's emotional and motivational state and potentially, guide a user towards more effective interactions with the system. The social companion's appearance can be realistic robot or virtual human as well as a simple speaker/microphone device. The behaviour of the social companion is controlled by the dialogue management, which will serve as the brain of the social companion arranging all the social interactions with the elder. All verbal behaviour displayed by the social companion has to be socially appropriate. To achieve this, a set of dialogue patterns are defined based on fluid real human communication practiced by the older adults throughout life, in interacting, collaborating and sharing with a real partner/carer while carrying out daily activities.

6.3 Appearance of the Social Companion

The core of the social companion is its dialogue management system which attempts to understand the user and generates the appropriate output. However, the appearance of the social companion can also have a significant effect on the user experience using the system. Literature has shown that too realistic appearance can have negative consequences on the user experience due to the phenomenon known as the “uncanny valley”. Realistic appearance and experience may in certain situations give the user an uncomfortable feeling. However, other novel research have shown potential of realistic appearance of social companions as robots or virtual humans. Most of these studies are conducted with younger generations and the question arises on what the older adults prefer as representation for the social companion.

To find out what older adults prefer, the consortium has tested four types of social companion with the user in the first pre-trials. The social companion was represented as 1) a wearable communication that can be attached to the user as a small pin or a necklace (Figure 12), 2) a regular speaker (Figure 13), 3) an expressive speaker (Figure 14) and 4) as an animated virtual human (Figure 15).

Based on the results it seems that the elderly users mainly preferred to have the companion as a regular speaker. This conclusion is taken into consideration in the design and development of the second prototype. The final product will be a system that is similar to Amazon Alexa but focused on interaction with older adults.

FIGURE 12 SOCIAL COMPANION AS A WEARABLE COMMUNICATOR (A SMALL PIN OR NECKLACE)

FIGURE 13 SOCIAL COMPANION AS A REGULAR SPEAKER

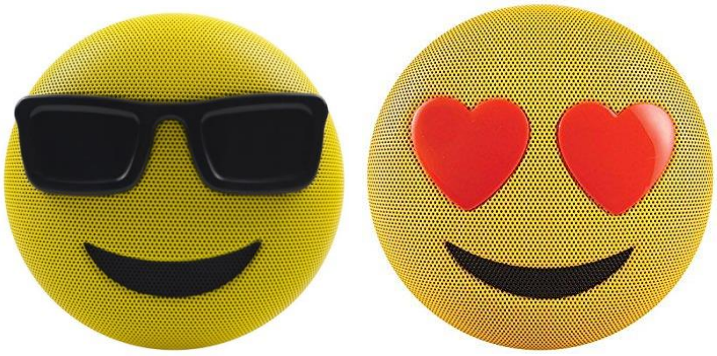


FIGURE 14 SOCIAL COMPANION AS AN EXPRESSIVE SPEAKER

FIGURE 15 SOCIAL COMPANION AS AN ANIMATED VIRTUAL AVATAR

6.4 Goals of the Social Companion

The social companion, as a virtual assistant organising the life of the older adults and interacting with them, has certain high-level goals that it often wants to reach. These high-level goals drive the social companion to take the appropriate decisions at every moment as well as to influence the emotional and adaptive behaviour of the social companion. In Motivational Psychology, a goal represents the desired state that should result from an action[12]. For Vizier's social companion, these desired states are related to the user's well-being as well as the user's satisfaction with the interaction and the overall system. Thus, we define goals that should assure that the user is physically, socially as well as cognitively active the whole time. Further, it is also important that the user is often in a positive emotional state and that the social companion does its best to satisfy the user's needs.

TABLE 1 APPETITIVE GOALS OF THE SOCIAL COMPANION

GOAL	DESCRIPTION
User is Physically Active	This goal is achieved whenever the user is engaged in activities that are considered beneficial for his or her physical state and is violated when there is a lack of engagement in such activities.

User is Socially Active	This goal is achieved whenever the user is socially active by contacting others, participating in activities with others, invites other users or accepts invitations from users. The goal is violated when such behaviour is lacking for prolonged periods.
User is Cognitively Active	This goal is achieved whenever the user is engaged in activities that are considered beneficial for his or her cognitive state (e.g. some example) and is violated when there is a lack of engagement in such activities.
User is Feeling Well	This goal is achieved whenever the social companion considers the user is feeling well and happy and is violated when not.

6.5 Dialogue Patterns

This section analyses all the information required to build an adaptive dialogue system for helping the older adults in their daily activities. It covers the structuring of the social companion interaction and on the adaptive parameters which will help the social companion to improve its interaction with the user.

6.5.1 The Structuring of the Dialogues

All verbal behaviour expressed by the social companion, either spoken or text messages, has to be socially appropriate and follow evidence-based guidelines for communication in the healthcare context. The social companion will use greetings and farewells, and make sure the user is addressed using their favourite form of address. The dialogue patterns cover the main high-level dialogue events, such as whether the social companion just asked the user a question and is waiting for a response, or whether the user just quit the application. The dialogue also includes patterns to handle error conditions, for example the case when the user stops interacting with the social companion in the middle of a conversation. In this case, the social companion may for example repeat its last utterance after a 30 second timeout, if the user still does not respond after two minutes the social companion asks "Are you there?", if there is still no response after another minute, the conversation is ended. If any internal errors are encountered during a conversation, the errors are logged by the system the social companion informs the user about the internal error. Both the user and the social companion can ask clarifying questions if they did not hear or understand something the speaker said. The social companion can take appropriate cues to terminate the interaction and ends the dialogue in a graceful way.

In order to build a relationship with the user, the social companion's utterances will reflect that the companion knows and remembers the user and conversations they have had in the past. This provides users with a sense of continuity, and more importantly, a sense of having been listened to and heard. This functionality will be supported by the component of episodic memory as described in the next section. For example, the social companion may refer back to previous interactions with the user or it may use a greeting such as "Hello, good to talk to you again!"

Table 2 below summarizes a preliminary list of multimodal interactions that the social companion is expected to support. The interaction takes place via speech or touch input in the content area in order to support social interaction between the social companion and the user and to guide the execution of specific tasks related to the ICT services offered by the system. An interaction can be initiated by the social companion or by the user and consists of a social companion task and an associated user action. This table will be revised in the second version of this deliverable; functionalities may be added and some of them may evolve or be deleted if they turn out not relevant.

TABLE 2: PRELIMINARY LIST OF MULTIMODAL INTERACTIONS THE SOCIAL COMPANION IS EXPECTED TO SUPPORT

SOCIAL COMPANION TASK	USER ACTION	INITIATIVE
Initiate interaction with Greeting	Return Greeting	Social Companion/User
Ask about user's state	Provide Answer / Refuse to Answer	Social Companion
Ask user for Input	Provide Answer / Refuse to Answer	Social Companion
Provide information to user	Acknowledge that Information has been heard/read	Social Companion
Provide feedback following user's input: **Verbal feedback** **Summary of user's input** **Display text if appropriate**	Acknowledge that information has been heard / read	Social Companion
Terminate interaction with graceful farewell	Say Goodbye / Request to terminate interaction	Social Companion/User
Issue Reminder/Notification	Acknowledge that message has been heard and/or action has been taken	Social Companion
Help user to use the system	Request for help and explanation	User
Step-by-Step navigation through the system	Navigation between tasks	User
Initiate service	Request service	User
Emergency management: **Acknowledge detection** **Contact caregiver**	Request emergency help	User
Error correction: **Repeat previous request** **Terminate interaction**	User does not respond to the system's requests in time	Social Companion
Clarify what the speaker said	Provide feedback	Social Companion/User
Express empathy verbally	Expresses a negative emotion	Social Companion

Ask when user needs further support from the social companion	Provide answer / Refuse to answer	Social Companion

Example Interaction:

A typical interaction consists of a brief conversation between the User and the Social Companion. An example of a dialog structure is shown in Table 3 below. Social dialog fragments can be inserted between any of the steps in the structure, for example based on the user's profile and the number of interactions the social companion has had with the user. Examples of conversational topics that the older adults could discuss with the social companion include: family and social ties, weather, future plans and questions by the user to the social companion. There is always a default dialog content that will be used by the social companion in the absence of any newly specified content.

TABLE 3: EXAMPLE OF SOCIAL COMPANION-USER DIALOG STRUCTURE

INTERACTION	DIALOG CONTENT
Initiate interaction with greeting	Social Companion: Hi Ben! Good to see you! User : Hello
Ask about user's state	Social Companion: How are you today? User: I'm not feeling so great.
Express empathy verbally	Social Companion: I'm sorry to hear that.
Talk about events that occurred since previous contact.	Social Companion: Have you been to see a doctor? User: Yes.
Ask user for input : Ask about user's daily plan	Social Companion: Good. Would you like to go to your painting class today? User: Yes.
Ask user for input : Review user's participation in past activities from personal agenda	Social Companion: Did you manage to go for a walk since we last talked? User : Yes , yesterday
Ask user for input : Negotiate next commitment to activities based on personal agenda	Social Companion: That's wonderful. Before we chat again, do you think you could get out and go for another walk? User: Sure
Ask if user needs further support from the social companion	Social Companion: Can I help you with something else? User: No, thank you.

Farewell	Social Companion: I'll talk to you later. Have a good afternoon Ben! User : Goodbye

ANNEXE

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