



LITERATURE REVIEW

Project deliverable D2.2

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Deliverable 2.1

LITERATURE REVIEW

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About this deliverable

This document is a review of heterogeneous research articles and products on the market focusing on sensors systems and novel interfaces. The deliverable is being compiled by doing a desk research at the beginning of the Helicopter project to give researchers an idea of the current status of the art and inspire the following concepts generation.

We deliberately decided not only to target elderly related researches and products, but to review examples according both to their novelty and potentials for being transferred to other application contexts.

We believe that a non stigmatizing approach already starts by mental modelling the research landscape where we operate.



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I.

INTRODUCTION

Conceptualizing ageing

The way we conceptualise ageing is highly reflected in the way we design products and services for the elderly. Before embarking into a literature review around sensors systems and data driven application for the elderly, we would like to define our approach around ageing as designers. Instead of considering the elderliness as a biological attribute, which automatically people get labelled with from the striking of a particular, yet conventional, year in their life, we approach ageing as a dynamic condition in which people manage to find new balances while cognitive and physical activities change through life.

Back to a previous research CIID run about the elderly and their relation with food (Allen and Boffi, 2010), a striking insight we gained by a conversation with Andrea, a caregiver, claims that: *“Aging is like going through different states of (temporary) equilibrium that the elderly achieve by creative interventions in their environment.”* This insight has informed all our following research with elderly people and shaped our approach in Ambient Assisted Living related projects. In the same way, Sabosi et al. (2014) highlight the importance of understanding ageing through the lived experiences of people who are older. In their paper, they suggest to adopt the perspective of “situated elderliness”, which rejects to classify the elderly according to their age, in favor of considering socially embedded situations and practices to make sense of the ageing felt experience (Brandt et al, 2014).

Framing ageing in this way helps us contributing to a fresh, new design culture around the elderly population and supports positive design thinking around seniors’ challenges. This is the reason why in this review we are not only focusing on literature, products and services labelled for the elderly, but we take the chance to investigate research, design solutions and strategies coming from other fields and meant for other user groups.

We have conceived this review to target the research domain as well as the market, and we structured it into 3 main categories:

- Interfaces and devices for the elderly
- Sensors based solutions
- Novel interaction strategies & interfaces

We aim that the contamination from different design examples, as well as un-focusing from the elderliness design domain could provide us with new inspiration and interesting stimulus for the Helicopter research.

II.

THE CONTEXT

IT & Elderly

Digital divide is a phenomenon in which, for a multitude of possible reasons, access or knowledge to information and communication technologies (ICT) causes a division in the population producing inequality. While it is apparent that the elderly have had a lower penetration of ICT usage, the nature of this difference is not clear. Several factors contribute for this situation. Therefore we need to try to decompose the landscape and untwirl the different possible confounding factors so we find which ones driving the variation. The biggest question, in our perspective, is if the divide is caused due to an age related impairment for ICT or if it is more a matter of generational experience (AKA birth year). The first scenario would push for a certain uniformity across different social, economic, cultural and experience level scenarios while the second would mean that differences found are mostly influenced by the scenario of a given individual.

With regards to Helicopter project we need ascertain the level of the currently still healthy and recently retired seniors, and the ones soon to reach this stage in life and that would be the potential users of a service like helicopter. Also it is specially relevant to establish the ex-istant scenario in Sweden and in the Netherlands, where the pilot will be implemented.

With the aim of understanding the characteristics of the penetration of ICT within the elderly populations of the pilot user base countries we looked not only at existing studies focusing on senior digital divide but we paid a special attention to data contained in the official statistics authorities of Sweden (SCB), Netherlands (CBS) and European Union (Eurostat). This data could help us understand both the evolution of usage amongst seniors and have a notion of its variation across Europe.

Looking at the portion of the population from the 27 EU members who have NEVER used the internet a massive disparity is revealed. The difference can reach 10-fold between countries making it unequivocal that factors other than only age play a huge part in ICT penetration. It also hints us that the pilot will be held in the leading

countries in Europe.

This is probably largely affected by the early policies of the top states in the informatisation of the country. NL and SE are pioneers in internet availability and usage. This means that today's elders were likely 15 to 25 yrs younger when they started using internet and therefore middle-aged and likely still professionally active. This likely means that potential users have a fairly high "comfort" with digital technologies. This becomes apparent when we look at the recent year evolution. There has been a tremendous increase in usage in the last 10 years amongst the 65-75yrs population. This, together with a still much lower user base amongst over 75-year-olds, indicates that the digital divide in these countries is not about age but generation (year of birth). There is also remaining evidence of another sort of inequality that has been brought up from the past, which is the much bigger gender gap amongst the older population compared to the younger, this is especially evident in the >75 year fraction, in which the internet activity of men is close to double of the female one.

For people born after the late 80's internet and IT devices were simply present (like TV and Radio for the vast majority of the world population) while for the ones born before that it was something introduced during their lifetime and after their main cognitive abilities have been developed. Therefore there is a transitional fraction of the population spanning across 30/40 years that range from "innate users" to absolute non users. The potential users of Helicopter lie mainly within this fraction.

When looking at the kind of usage that the older do of the internet in comparison with other age groups, we can see that half of 65 to 75-year-olds in NL and SE are daily users while ~¾ are at least occasional users. Also we see that this group's internet usage pattern reveals a close to average activity in Email, TV/Radio, News, trips/holidays, banking and information on goods/services. While being much lower in chatting, social media and online shopping.

THE STUDY

In a large study published in 2010, a determination of factors related to

the digital divide within demographics, health and social aspects was the goal. The target population for the study consisted of all noninstitutionalized persons 60 years or older living in the city of Detroit, MI (USA). 1310 participants were interviewed by phone while 100 face-to-face.

For the demographic assessment it was gathered the following information: age, gender, education, employment status, income and race/ethnic group.

For the health assessment it was determined the following: doctor visits in the past 12 months, including hospitals, nursing homes and other long-term care facilities; prescription medicines and chronic health conditions.

Finally the social activity of the participants was also inquired. This includes active leisure time activities participation and how much it was enjoyed (both activities that require and don't require the participants to leave their home), membership in a community organisation and volunteer work.

The main findings in the study were that Urban adults seem to have similar prevalence of computer to older adults in general. Also that computer users tend to have higher education, be younger, have higher income, more likely to be employed and were healthier and more active than non users. It was interesting to reveal that although some modifications in the learning environment may be needed, many older adults are eager to learn about computers and the Internet when given the opportunity and training. They may also become just as enthusiastic and active online as younger users.

When this data is compared with our findings we see that US Data shows that only about a third of the >65 years are using computers. this data is very different from what we find in Netherlands and Sweden where over 3/4 use the internet at least occasionally and 50% do it in a daily basis. So it would be erroneous to consider that the participants of Helicopter have the same exact constraints as these Detroit elders.

Relevantly, and despite being of a low percentage in the pilot countries, it is still important to account for the most vulnerable older adults in terms of health and economic status which are risk of becoming digi-

tally excluded.

To conclude, we found that the swedish and dutch users should not be considered IT inapt just because they are old. We would risk giving them tools and services that are below their skills and standard expectations causing demotivation and lack of interest. With that said it is important to acknowledge espite being IT aware the sernior users might have different patterns of usage of the rest of the population.

II.

CASE STUDIES

CATEGORY 1:

Interfaces and devices for
the elderly

The importance of interface choices in making health data reach the user

An Evaluation of Wellness Assessment Visualizations for Older Adults (Thai Le et al., 2015)

WHAT

With the use of elderly focus groups this study aimed at assessing the effectiveness of different types of visualisations of data originated from health monitoring devices installed in homes.

HOW

With the goal of filling a lack of studies in the field of health visualisation for the elderly consumer this research was performed with the involvement of 31 older citizens that are residents in both private apartments and assisted living homes. The chosen elderly were still independent in activities of daily living.

Three themes were under scrutiny: values of visualizations for wellness assessment, cognitive processing approaches to visualisations, and integration of health data for visualization. At the graphical level three styles of visualisations were tested: Bar and line plots, radial plot and “light ball metaphor”.

The prototypes followed 4 main design cues: display comparison; display trend; keep it simple; and provide focus.

RELEVANCE TO HELICOPTER

WHAT TO CONSIDER

- A certain familiarity with the means of communication is a key for the smoothness of the information exchange. Numbers, lines and bars were generally well received and perceived.
- Segregation of wellness components was important for the participants (opposed to a single “Wellness” score) as it allowed comparison of apples with apples.

WHAT SHOULD BE AVOIDED

- Consider that the participants of Helicopter have the same exact constraints as these Washington state elderly people.
- Despite the different kinds of plots the remainder of the interface remains the same and is not under any comparative scrutiny.
- Holist abstraction of data led to confusion and feeling of arbitrary feedback. It is important to keep objectivity on what is being shown.
- Excessive representative colours and shades was not welcomed.

Radial plot



Light ball metaphor



HEALTH-E
Take a Measurement
Change Settings

Laura Fisher

My Wellness

Last updated:
5 days ago on Oct 17, 2011

Doctor's Note 1

Results looking good!
Oct 21, 2011
Hi Laura, I just reviewed the CT result and looks good to me...

Calendar

TODAY
Jane's Birthday
4:30 pm Hair Cut

TOMORROW
6 pm Jane's Birthday Party

Next Week

MONDAY
10:30 am Doctor's Appointm...
12 pm Lunch with Paul, Harry...

TUESDAY
7 pm Movies night

THURSDAY
8 pm Happy Hour

FRIDAY
11 am Lunch with Amy, Sam
3 pm Shopping

Messages 3

Re: Happy Birthday Jane!
27 mins ago
Thanks, Laura :) I am having a wonderful day. Are you comi...

My Wellness in October 2011

ME	My Community	My Age Group
81.5	74.2	65

Low Good Excellent

previous month ◀ October 2011 ▶ next month

My Wellness Score Is
81.5/100

PHYSICAL	COGNITIVE
78	82
SOCIAL	SPIRITUAL
95	71

My progress over the last 12 months

Excellent
Good
Low

Nov-2010 Dec-2010 Jan-2011 Feb-2011 Mar-2011 Apr-2011 May-2011 Jun-2011 Jul-2011 Aug-2011 Sep-2011 Oct-2011

Overview Physical Cognitive Social Spiritual

Interface design with bar and line plots

Co-creation applied in Sweden

Participatory Design With Seniors: Design of Future Services and Iterative Refinements of Interactive eHealth Services for Old Citizens (Scandurra & Sjölander, 2013)

WHAT

This case study aimed to investigate novel eHealth services for elderly citizens together with seniors, using an interactive device designed for seniors.

HOW

The research was performed with the involvement of older citizens that were still independent enough to live by themselves and to frequently visit a senior centre. It uses a prototype (IPPI) that connects with the a TV the users would already have. It is capable of sending and receiving both text and voice messages between other internet functions

For the IPPI development It was believed using a TV would reduce new users' uncertainty thus being advantageous over computers and mobile devices with regards to motivation to start and continue using the system. This system takes interaction cues from older technologies, such as answering machines and TVs.

An integrated development has been attempted over the course of 1,5 years.. "In this environment, problem-owners, health informatics researchers, elderly users, and developers of novel IT services worked together in a user-centered and participatory design approach".

RELEVANCE TO HELICOPTER

WHAT TO CONSIDER

- This study reinforced the importance and the benefits of using older people's knowledge and experience in the development of new products.
- In this case the researchers' work was to support direct communication between users and developers rather than gather material to hand over to the non-present developers. If the developers would not be present at the workshops, much explanation time would be consumed and a real understanding for the users' needs and preferences could be lost.
- The system should maintain previous channels of communication, between the elders and their beloved, intact.
- To have an attractive interface and device is important to ensure the connection between the users and the product
- Most seniors installed the device by themselves and, when not, the problem was the physical cable connection.
- The services introduced due to the elders feedback were quiz and memory games and weekly distributed workout exercises

- The seniors appreciated that they could learn the technology together with other participants who were at the same level (cognitively active elders living on their own)
- Participation also seems to have opened up the participants' interest in technology beyond this device and its services, a spillover effect of daring and learning new things within this project.
- Despite having a lot of capabilities, in the end the participants mostly used the system to receive and reply to event invitations of the senior centre.
- The device was criticised for being too old fashioned in its physical and interface design and cumbersome to input text and navigate.

WHAT SHOULD BE AVOIDED

- Despite being powered by mobile (GSM) technologies it is close to useless without a TV and therefore not portable, even inside the house. (Say it was connected in the living room and the elder was in bed)

The IPPI device and interface



A tangible user interface for the elderly to program their smart environment

Empowering the elderly end users for ambient programming: the tangible way. (Criel et al., 2011)

WHAT

Thanks to a tangible user interface consisting of NFC enabled magnetic cards and an augmented memo board, the elderly can program smart objects in their homes (such as the tv or the photo frame) and subsequently modify or deactivate the smart behaviours associated to them.

HOW

First, the elderly has to create a smart behaviour. To do that, the elderly places a blank NFC enabled magnetic card on the touch screen terminal and he gets prompted to select a behaviour template available from the collection. The elderly customizes the behaviour introducing details such as conditions, objects and actions. When he has done, he can print a representative image to stick on the blank card.

To activate the behaviour, the senior just needs to place the card in one of the framed spots on the augmented memo board. The LED under the frame will light up, indicating that the behaviour is activated now.

To deactivate the behaviour, the elderly has to remove the corresponding card from the board.

RELEVANCE TO HELICOPTER

WHAT TO CONSIDER

- The elderly are engaged in a creative way in the creation of smart behaviours, thus increasing their understanding of the system and its adoption.
- Delegating the programming to the elderly themselves increases the chance that personal needs are met.
- Caregivers can support the elderly in the programming when the technology demands are too high.
- Creating their smart system contributes to give elderly control on their life and a sense of ownership.
- It is important that the system is intelligible to the elderly: large and visual feedback is essential for the elderly to feel in control.
- Tangibility is of added value over the digital for the elderly population.

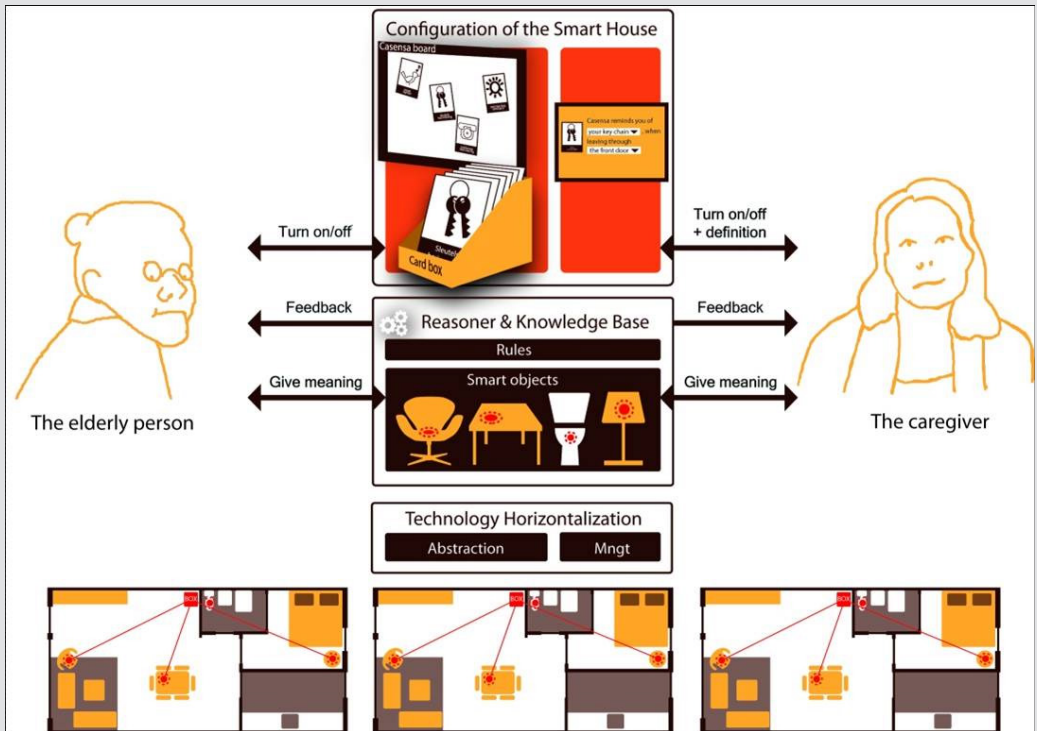
WHAT SHOULD BE AVOIDED

- Behaviour templates are limited.
- The behaviour creation could be particularly demanding for the elderly.

The behaviour creation on the touch screen terminal



Placing a NFC enabled magnetic card on the augmented memo board



The configuration of the smart system

Getting more socially connected through peripheral interactions

Peripheral Interaction in Two Metaphor-based Communication Tools. (Dan & Baeker, 2014)

WHAT

The InTouch project allows the elderly to have an asynchronous communication with their relatives through domestic augmented objects, such as a photo frame and a tv.

HOW

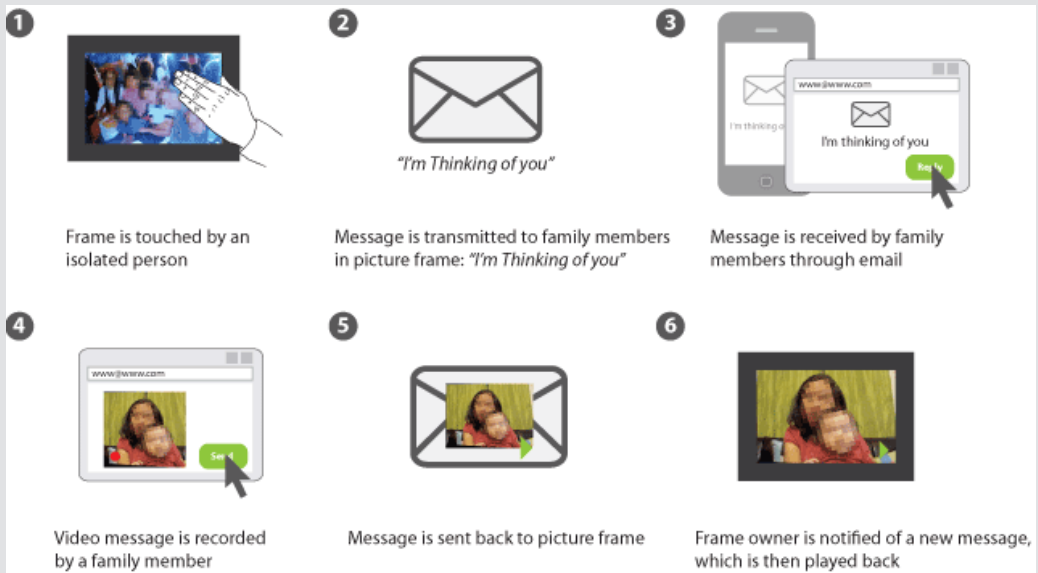
Two familiar objects, such as the photo frame and the tv, have been augmented in elderly household in order to allow asynchronous communications with distant relatives. Without having to interface themselves with a computer, the elderly can send a wave, a photo, an audio or a video message to a relative. They can do that either by tapping on the related button on the photo frame display or by selecting the function on the tv screen from the tv remote control. The photo frame display has been implemented on a tablet. Instead, the tv remote control consists of an app running on a mobile phone. The mobile also performs as the photo/video camera if the elderly selects the “send a photo” or “send a video” function on his tv. On the other hand, the relatives can answer back to the elderly and their messages will be displayed in the photo frame and in the tv.

RELEVANCE TO HELICOPTER

WHAT TO CONSIDER

- The use of communications metaphors, such as a photo frame and the tv, instead of the computer, appears to be less threatening to the elderly.
- To mimic real world objects with augmented capabilities is welcomed by seniors because they are familiar with them.
- Enabling peripheral interactions with augmented domestic objects seems to be a promising direction because it would allow a more seamless experience without adding any cognitive burden to the elderly.
- The interactive devices focus only on a few functions that seem to be particularly relevant to the seniors (to send different media messages to relatives; to poke relatives; to receive messages from them).

The system diagram around the interactions with the photo frame



CATEGORY 2 :

Sensors based solutions

The first full home sensing service in the market. Technology-driven design?

Cube Sensors (<https://www.cubesensors.com>)

WHAT

Portable room sensors that measure air quality, temperature, humidity, noise, light, pressure and shaking.

HOW

This product aims at helping the user to better understand their own home or office and learn what to improve to make the user “feel better” in the environment where it is installed.

The system adds to the Internet of Things trend and connects to a webapp that is compatible with smartphones, tablets and computers.

The system requires a base stations to be permanently connected to a power outlet and to a wired LAN. This base station is responsible for gathering the information being obtained by the cube sensors and to communicate it to the company’s servers.

RELEVANCE TO HELICOPTER

WHAT TO CONSIDER

- The small and delicate design of the cubes makes them plausible to have in a home and be integrated with the existing decoration.
- Quick feedback by the means of light

signals if the conditions of the room become unhealthy and/or unsuitable

- Can be programed to gently pulse in each room when it is time for the bedtime routine. It also helps to monitor sleep and with the information of the 7 sensors it contains tries to understand the reasons behind nights of bad sleep.
- Flexible in usage, the same hardware can be used for different purposes and rooms.
- It allows, with a simple shake, to get immediate feedback on the room’s conditions and at the same time it reassures the user that it is still functioning.

WHAT SHOULD BE AVOIDED

- The complete reliance on the sensors for well being instead of one’s own senses.
- This product has an aura of technology driven innovation, where the functions came later. Recent add-ons to the service have changed the focus of the product to the monitoring of sleep. This makes it yet another way of monitoring sleep, on top of wearables, mobiles and pressure sensors.
- Despite being wireless the cubes need to be recharged periodically by cable. it is not a install and forget system.

Different options to position the sensor and the Cubesensor



Freelancer sensors to track what means to you

Mother (<https://www.sen.se/store/mother/>)

WHAT

A flexible sensor system composed by a basic unit (the doll shaped Mother) and its sensors (the Cookies) that can be freely attached to objects and persons to detect movement and temperature. A browser-based dashboard visualizes everything you decided to track as a storybook.

HOW

The Mother unit works as a data collection center that communicates with the sensors. The sensors can be assigned to whatever activity the user decides to track, from brushing the teeth to the amount of coffee brewed during the day, by sticking the sensors to the object or person to monitor. The data are visualized on a browser dashboard in the shape of a storybook, so that you can easily keep track both of your routines and abnormal behaviours and take actions on that thanks to the friendly encouragement prompted through the dashboard.

RELEVANCE TO HELICOPTER

WHAT TO CONSIDER

- The gentle metaphor and shapes of the Mother and Cookies make the system more friendly and easy to learn at the beginning.
- The sensor works as “freelancers” and they can be assigned to monitor whatever the

user finds meaningful for himself. The user can reassign the cookie to track a new activity all the times he wants.

- The product design is emotional enough, without being cheesy.
- The storybook dashboard focuses on the whole records of the persons, not only on the bad ones, encouraging the user to look at it not only to correct himself for his bad behaviours, but to learn from it about himself and his routines.
- The installation is completely done by the user, increasing his sense of ownership on the system.

WHAT SHOULD BE AVOIDED

- The brand “Mother” sounds not really fitting the concept of “freelance” sensors.
- The sensors have limited sensing capabilities: motion and temperature. Thus, the activities range that can be sensed is not broad.

The Mother Unit



A sensor Cookie attached to the keyholder to monitor who comes back home



An application of the Mother system



I want my baby to
always feel warm and
cosy

The Cookie on his
bedroom wall alerts me
if it gets too cold

CATEGORY 3:

Novel interaction
strategies and interfaces

Health Information Exchange user study. Possible behaviour change implications.

Older adult consumers' attitudes and preferences on electronic patient-physician messaging. (Lam et al, 2013)

WHAT

Assessment of older adult consumers with regards to health information exchange services

HOW

This user-study has been made while the pilot program of Vision Tree[®] was underway. Vision Tree[®] is a secured two-way messaging service that allows patients and caregivers to communicate with their associated medical care team. In this service the messages to the medical care team are triaged by medical staff. Issues that can be competently answered by the first line of staff are handled by them while questions that require a physician's attention are forwarded to the adequate physicians.

This study surveyed patients that have shown interest in the system. These were sent their personal login details to use the service. The group was then divided into two groups, the ones that have not logged in to the system constitute the group of "non-users" making the group of "users" the ones that have logged in at least once.

The patients were also asked to answer a sur-

vey. The questions ranged from age, frequency of health care visits, preferred methods of communication with the medical office and how were they introduced to the system. For the group "users" specific question about the system were asked, such as: for how long have they been using it, ease of use, nature of the message they sent, barriers to use and overa

ll satisfactions. At the end of a survey an open-ended question was also asked about suggestions for improvement of the messaging system.

RELEVANCE TO HELICOPTER

WHAT TO CONSIDER

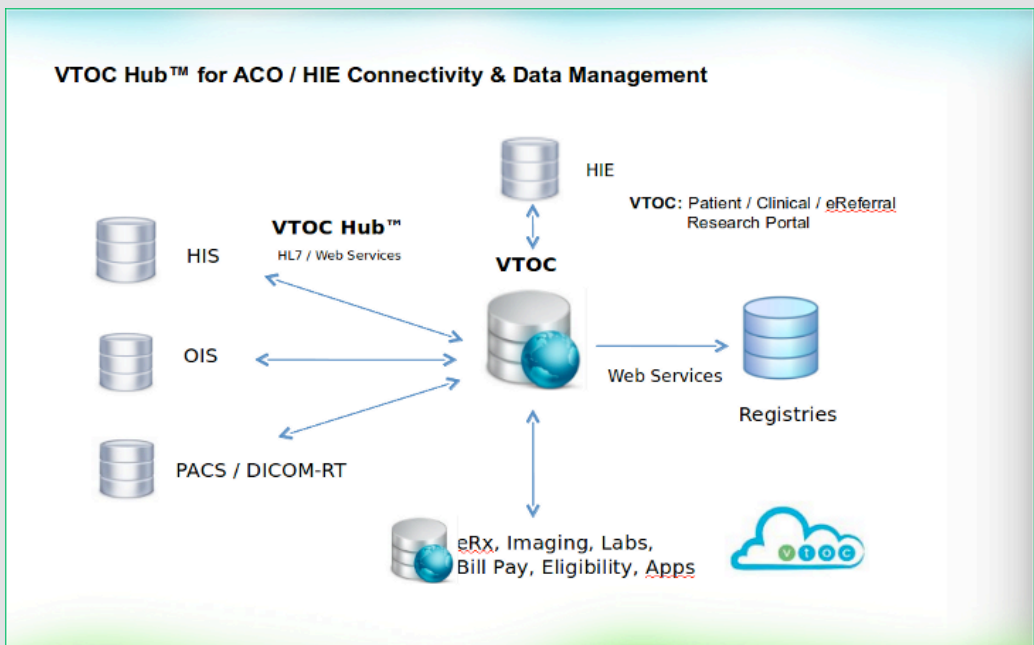
- When asked, few barriers were reported by users, with forgetting username or password being most common.
- Albeit the phone is still the most used mean of communication with the medical teams both younger and older adults assumed a preference of the email instead.
- Engagement of the medical staff in using the system is critical in the utilisation rate. While we might be focusing on the user preferences a careful design of the service and interface for the other actors in the system mustn't be neglected.

- Older adults patients with some experience in electronic communication should have no problems embracing eHIE

WHAT SHOULD BE AVOIDED

- Users of HIE systems seem to make more frequent visits to the doctor. If done unnecessarily this would defeat the triage purpose of Helicopter and overwhelm the medical services rather than helping to make a better use of these resources.

Caption



Shifting between center to periphery of attention

Peripheral interaction. (Bakker, 2014)

WHAT

Peripheral interactions are all those interactions we do not pay conscious attention to and that shift to the center of attention only when relevant. Regarding technological devices, they consist of the exchange of data with the users through multiple modalities that do not require focused attention (sound, physical interactions, etc). For the rest of the time, the devices remain in the background without overwhelming the people with unnecessary information.

HOW

In our daily life we experience a multitude of peripheral interactions with our surroundings. From the sounds of the rain that informs us to bring an umbrella when leaving home, to the sound of our dishwasher that tells us that the cycle finished. We are not paying a conscious attention to this information, but we still process it because it is part of our environment and becomes part of our routine. An example is the LightCube (Offermans e a., 2014), a physical cube which acts as the controller of an environmental lighting system, usually controlled through a smart phone app. It allows to switch between six light settings through a single movement without focusing on a GUI.

RELEVANCE TO HELICOPTER

WHAT TO CONSIDER

- The peripheral interactions integrate seamlessly in the daily routines because they require attention only when relevant.
- Peripheral interactions contribute in making people feel in control of the technology, without being overburdened by it.
- Physical interaction styles and multiple modalities for interactions between users and devices should be exploited to allow more peripheral, unfocused, interactions. This also avoid going through (visual) menus to interact with the device.

WHAT SHOULD BE AVOIDED

- The dominance of the screen in computer interfaces forces the users to have a focused interaction with the device, thus making it obtrusive.
- The more the interface is visually populated with images and text, the more it requires focused attention.

The LightCube interface for ambient lighting.



IV.

CONCLUSIONS



The journey we took into this literature review allowed us to discover new approaches into sensors systems and interfaces.

The effort in making the sensors more flexible, user-customizable and even user-programmable seems to have also brought consequences into the physical aspects of the sensors and the physical interactions that the user is supposed to perform with them. Sensors start to be shown in the house, instead of being hidden, or worn as appendix of the body or other objects we carry with us. Depending on where the sensors will “inhabit”, a new kind of symbiotic relationship between the sensors and the users or the sensors and particular objects of the domestic environment emerge. Moreover, by conquering a recognized physical appearance and a visible place in the home, a sensor emancipates itself as a physical interface to interact with, at least for the extent of its collocation, if not for some kind of feedback it could already releases (like sound or light).

On the other side, we see the emergence of two different meanings around the “interface”. Interfaces becomes affective, when they convey emotional content or very personal information. In this way, even a dashboard collecting data from domestic sensors could be qualified with a different meaning other than just an information visualizer to people interacting with them.

Another emerging connotation of interfaces dealing with sensors data is related on how often and how “focused” people will look at them and consult them. This peripheral or central attention on the interface will depend on the frequency and quality of the feedback coming from the sensors system. It seems that we would be interacting with such interfaces in a different and very variable pace than what we do with our smartphones or tablets, which, no matter the content, use to force us to a focused and proximal interaction with its touchscreen display. The emerging interface that we see on the horizon will allow that the focus of our interaction with it will modulate over time, going from an environmental “awareness”, or invitation, to check it, to a deep digging into its visualization.

The reflections above will converge into the concept generation phase together with the insights gained during the people centred research which was discussed in the Deliverable 2.1.

V.

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