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End-User Requirements

Phase A

Project identification	
Project Number	Memento
Duration	30 months
Coordinator	Jon Arambarri
Coordinator Institution	VirtualWare
Website	www.memento-project.eu

Document Identification	
Deliverable ID	D2.2A
Release number/date	V09 / 06.08.2018
Checked and released by	Sten Hanke (AIT)
Work Status	closed
Review Status	reviewed

Key Information from "Description of Work"	
Deliverable Description	The deliverable summarizes the end user requirements
Dissemination Level	Public
Deliverable Type	Report
Original due date	31.08.2017

Authorship & Reviewer Information	
Editor	Günter Kubicki
Partners contributing	MUV, UNIPG, Wetouch
Reviewed by	Sten Hanke (AIT)

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Release History

Release Nr	Date	Author(s)	Release Description/Changes made
V01	07.11.2017	Sten Hanke (AIT)	Table of Content first version
V02	20.02.2018	Günter Kubicki (Wetouch)	Add chapters from D2.3
V03	23.02.2018	Christian Schüler (Wetouch)	Added list of requirements
V04	11.06.2018	Günter Kubicki (Wetouch)	Add executive summary, verify changes to requirement list.
V05	12.06.2018	Günter Kubicki (Wetouch)	Add content for chapter 2, formatting, split list of requirements into functional and non-functional
V06	18.06.2018	Günter Kubicki (Wetouch)	Merge V05 and V06
V07	26.06.2018	Günter Kubicki (Wetouch)	Review comments / changes, complete Memento consortium table, document information
V8	04.07.2018	König Theresa (MUV)	Add personas from Vienna
V9	16.07.2018	Günter Kubicki (Wetouch)	ToC, formatting, add abbreviations
V10	06.08.2018	Sten Hanke (AIT)	Close Deliverable

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Abbreviations

Abbrev.	Description
AAL	Ambient Assisted Living
ACE-R	Addenbrooke's Cognitive Examination Revised
AD	Alzheimer's Disease
ADL	Activities of Daily Living
CDR	Clinical Dementia Rating
CRIq	Cognitive Reserve Index Questionnaire
FCSRT	Free and Cue Selective Reminding Test
IADL	Instrumental Activities of Daily Living
ICT	Information and Communication Technology
MCI	Mild Cognitive Impairment
MMSE	Mini-Mental State Examination
TMT	Trail Making Test

Executive Summary

This document revolves around the end-user requirements for the Memento hardware and software system design. It describes more common topics, such as design principles for people with dementia, and concentrates on the specific issues at hand in the course of the document. The requirements per se are based upon the aforementioned principles and topics, completing a user centered design research approach.

The results of the requirement engineering research processes are distilled in a list of functional and non-functional requirements, each for the hardware and software side of the system.

1 About this Document

1.1 Role of the Deliverable

1.1.1 Description of Work WP2

“The objective of this work package is to investigate user’s demand on interaction preferences and aesthetics in product appearance, which is a key factor for creating an emotional experience with a product or service, and to design use cases and scenarios to ensure that the system’s services and products address user needs and fit into user’s daily routines.” (Memento DoW, p. 12).

Description of Work Task 2.2

“This task will research new methods and processes that determine the factors relevant for assessing the user needs in the early stages of the project. User requirements gathered through the qualitative value centred approach will reveal technology acceptance factors as well as emotional, haptic and aesthetic influences that are the basis for the design and the implementation of product modules. In this task, we apply a mix of qualitative methods of empirical social research and design research methods, which will be defined and prepared by BKM. Methods include Questionnaires, Interviews, Cultural Probes, Focus Groups and Design Workshops and will be presented in advance by info-talks to participants. The user-based methods shall involve 5 of users (with dementia in different stages) from Austria recruited by MUW, 5 of users (with dementia in different stages) from Spain recruited by Bidaideak and 5 of users (with dementia in different stages) from Italy recruited by UNIPG. The study – Phase A - will be conducted from month 1 – 4, the second study – Phase B - starts in month 15 - 17 of the project. The results of this task will feed directly into all work packages to ensure the strong user centred focus of the project. The outcome of this task shall be a detailed report on the user requirements regarding to the MEMENTO system in D2.2 End-user requirements – Phase A. The results of this task will feed directly into T2.3 Definition of use cases and scenarios – Phase A and will contribute later to the development of prototype I.” (Memento DoW, p. 13)

1.2 Relationship to other Memento Deliverables

Task 2.2 represents the foundation for certain follow-up work packages as well as the development of a first prototype.

Deliverable	Relation
D2.3 – Definition of Use Cases and Scenarios	The findings of this deliverable feed into the creation of use cases and scenarios, and from there into the development of a first prototype.
D3.1 – Specification of Hardware Design and User Interface	Describes the user interface design for the software components.
D4.1 A – Hardware Specification	Specifies the hardware design and user experience.
D5.1 A – Software Specification	Specifies the software user interface design and user experience.

2 Methodology

The methodology used in this collaborative design research project is aiming at generating scenarios that provide an evidence-based ground for the design process. The methodology is based on three main elements: (1) design research data gained at visits in the homes of twelve people with dementia and their caregivers; (2) problem scenarios developed on the basis of the design research and (3) activity scenarios, developed in a co-creation workshop with consortium members from design, medicine, hardware and software design. The results of these three main elements in Austria and Italy are contrasted and evaluated in this first phase by a panel of experts in Bizkaia, Spain. In the following sections, the three elements will be described in more detail.

2.1 Design Research

The research design follows a combination of problem and potential focus, building on informants' existing strategies for coping with dementia in everyday life. This approach is a contemporary move towards 'the ingenuity of ageing' (see (Lee and Moore, 2015) trying to move away from concentrating on failure and problem only but honoring the ideas and concepts developed by expert users (Coleman, 2015). The design research consists of the three parts: *Strategies of Remembering*, *Product World* and *Diary for a Week*. While part one and two are documented by the researcher, part three is handed over to the informant to fill in autonomously. *Strategies of Remembering* aim to learn from the informants' own strategies of remembering and consequently asks: What tools do you use to remember dates, plans or events? The section *Product World* is intended to help the project team understand which technical equipment, informants already use at the moment and which products are generally appreciated. The analysis of informants' familiarity with technology should give the research team a realistic insight into how advanced the design of the future solution might be. *Diary for a Week* asks informants to record everyday situations where an intelligent reminder assistance could be useful. By describing specific everyday situations, contextualized data could be taken as a point of departure for the later development of use cases and scenarios.

Six users in Austria and six users in Italy were visited in their homes, the meetings lasted two hours on average. Researchers took notes and pictures of relevant objects.

The contribution of Bidaideak and the Spanish team is based in two actions: a) Phase A. The contribution at this stage is based on a panel of experts composed by 5 highly experienced professionals in the area: 1) R4 Biomedical researcher, Vice-dean of Grades Coordination and Development, Neurosciences Department, Faculty of Medicine and infirmary, University of Basque Country, Leioa-Bizkaia; 2) R4 Biomedical researcher, Neurologist, Head of Neurology Department in Cruces Hospital-Bilbao and within the Faculty of Medicine and infirmary, Neurosciences Department, University of Basque Country, Leioa-Bizkaia; 3) R3 researcher, Neuropsychologist, Neurosciences Department, University of Basque Country, Leioa-Bizkaia; 4) R3 researcher, Psychologist, Bidaideak's research coordinator; Neurosciences Department, University of Basque Country, Leioa-Bizkaia, ; 5) Sociologist/Social Worker, Bidaideak. And action b) Phase B. Lab Trials with 5 users; Field Trials with 5 users in a test group and 5 users at the control group.

2.2 Recruitment

The project follows a strong user-centered design as well as a participatory design approach that involve users in the requirements analysis (WP2), user experience design (WP3) and the usability engineering and the evaluation tasks (WP7). The end-users of the project are defined by people with dementia, mild cognitive impairment, and memory problems as well as their relatives and caregivers.

In the requirement analysis phase of the project (WP2) the end-user is involved with the aim to identifying needs, services and their functions requested (ranking), user interaction analysis, designing pervasive input/output devices.

The inclusion and exclusion criteria expected from the project concern both cognitive aspects (MMSE scale) and patients' characteristics (age, gender, residential status) as well as computer skills for both primary end users and the family. In particular, the test group includes persons able to run the MEMENTO platform and use of its functionalities (e.g. set reminders, manage the calendar, use of all-day device etc.). At the same time, the control group includes persons that use traditional tools needed to carry out daily living activities (e.g. traditional post-it to set reminders, a traditional calendar to set appointments or reminders for drugs intake). Moreover, the

project contemplates the use of questionnaires for both primary end users and secondary end users (family).

Starting from these assumptions, inclusion and exclusion criteria recruitment were developed considering real clinical case description of persons with cognitive impairment afferent to University of Perugia and MUW, in order to keep a link with real situations. They differed in life style and educational level. All of them could entertain a conversation and express an opinion.

The descriptions were achieved considering the relevant factors in biopsychosocial model (Engel, 1977):

- Lifestyle and family relationship
- Health conditions
- Social aspects

In order to deeply describe the situation specification was given to:

- Limitation and difficulties in daily living activities;
- Diseases and symptoms
- Psychological problems
- Drug use
- Visual and hearing sensibility

Moreover, since MEMENTO solution comprises different devices, also three areas were considered:

- Technology usage
- General attitude towards technology
- Devices in use

In order to establish the recruitment criteria, a consensus process procedure was developed.

From the clinical point of view, it was important to define a cognitive and functional profile of the user case with cognitive impairment. In particular the consensus regarded the admitted level of impairment in this phase.

The clinical interview is used to collect information about the clinical and socio-demographical condition (illnesses, comorbidity, pharmacological therapy, clinical history, sensorial impairment, educational level, social condition).

Several assessment instruments (scale and test) were chosen among the most used in this area, an aspect that allows sharing clear patient selection

criteria referring to the severity of the impairment, and the level of functional and cognitive impairment.

The severity of dementia is evaluated by means of the Clinical Dementia Rating Scale (CDR- Morris, 1993).

A score equal 0.5 or 1 respectively corresponding to “very mild dementia” and “mild dementia” was chosen to guarantee the possibility to interact.

Functional status is assessed by means of the Basic Activities of Daily Living Scale (ADL; Katz, Ford, Moskowitz, Jackson, & Jaffe, 1963) and the Instrumental Activities of Daily Living (IADL; Lawton & Brody, 1969) scales. These scales provide questions about independence in basic (bathing, dressing, toileting, transferring, continence, and feeding) and instrumental (using the telephone, shopping, meal preparation, housekeeping, laundry, use of transportation, self-administration of drugs, and handling finances) activities of daily living.

To ensure the old people (age 75–85 years) participation, minimal supervision at the basic activities of daily living or minimal disabilities in instrumental activities of daily living due to physical problems are admitted (i.e. help in taking a shower).

Since the incontinence is a frequent problem in aging people, occasional incontinence is admitted.

Respect to daily living activities the ability to dial a few well-known numbers on the cellular phone and to get around (or travel) outside the home (alone or accompanied) are considered inclusion criteria. The use of the cellular phone guarantees a minimal ability to execute a procedure. The ability to get around outside of home concern a minimal active lifestyle.

Global cognitive assessment is developed by means of the Mini-Mental State Examination (MMSE; Folstein, Folstein McHugh, 1975).

It's a widely used cognitive screening test available in different language with fairly well understood scores by clinicians (Pernecky et al., 2006). The MMSE sensibility to mild cognitive impairment is debated (Mitchell, 2009) and a correspondence between MMSE and CDR it has been identified (Pernecky et al., 2006). According to this correspondence, a MMSE score in the range 26-29 indicates questionable dementia while a score in the range 21-25 indicates mild dementia. In order to include subjects with mild cognitive impairment and mild dementia a MMSE score ranging from 24 to 28 it was admitted.

In some cases, the ability to perform the Addenbrooke's Cognitive Examination Revised (ACE-R; Mioshi, Dawson, Mitchell, Arnold and

Hodges, 2006), the Trail Making Test A and B (TMT A and B, Reitan, 1958) and the Free and Cue Selective Reminding Test (FCSRT, Grober, Sanders, Hall, & Lipton, 2010) score were considered to ensure minimal attention and executive function abilities despite memory deficits.

Normal social functioning in the community, no history of psychiatric or neurological diseases, no history of traumatic brain injury or stroke, no history of alcohol abuse or psychotropic drugs, or clinical evidence of depression are requested in order to ensure that a degenerative illness is the cause of the cognitive problems.

In order to avoid selecting a sample of “supernormal” participants, we did not exclude individuals with pharmacologically well-compensated hypertension, diabetes, and anxious/depressive symptoms. Corrected sensory deficits were allowed.

Primary school as minimal education level was required in order to exclude illiterate persons.

Considering the importance of the cognitive reserve, the Cognitive Reserve Index Questionnaire (CRIq, Nucci et al., 2012) was included.

The technical proficiency level of users and caregivers, was assessed by means of a Likert scale ranging from “Not at all” (level 1) to “Very Familiar” (level 6).

As the project contemplates an informant involvement, subjects with available caregivers are to be preferred respect to people who live alone.

Table 2 resumes the inclusion and exclusion criteria.

Table 2 CRIq is a cognitive reserve measure (Nucci et al., 2012); Technical proficiency was assessed by means of a Likert scale ranging from "Not at all" (level 1) to "Very familiar" (level 6).

PATIENT SELECTION CRITERIA	
Diagnosis of MCI due to AD and mild AD (amnestic type) (McKhann et al. criteria 2011)	
Flexibility in ADL and IADL Index of Independence in Katz Index of Activities of Daily Living) (ADL) equals 5 or 6 (occasional incontinence is admitted)	
Lawton - Brody Instrumental Activities Of Daily Living Scale (I.A.D.L.) equal or below 5	a. subjects must be able to dial a few well-known numbers on the cellular phone b. subjects that are able to get around (or travel) outside of the home (alone or accompanied)

no history of traumatic brain injury; no history of neurological disorders; no clinical evidence or history of mental disorders; pharmacological well-compensated hypertension, diabetes, and anxious/depressive symptoms
corrected sensory deficits
primary school as minimal education level
Cognitive deficits documented as follows
correct total score Mini-Mental State Examination (MMSE) ranging from 24 to 28
Different levels of cognitive reserve (CRIq* scores)
Different levels of Technical Proficiency**
subjects who living alone with an informal supervisor (son/daughter/niece) or subjects who live with their spouse

In order to give the Memento designers a wide overview of future user profiles, four different persona's descriptions (two from University of Vienna and two from University of Perugia) have been developed (Figure 1-4). Each persona's description represents a prototypical clinical case. As Vienna is a unit of neurology, we expected patients younger than those in Perugia, which is a geriatric reality. The Spanish panel of experts also expect to have elder users than Vienna, a similar situation than those recruited in Perugia.

Mario ROSSI

Perugia, Italy



Age: 74; Educational level = primary school; Occupation: owner and manager of a bar; CDR = 0,5; ADL = 6/6; IADL 6/8; able to perform the TMT A and B; correct MMSE = 25/30; correct ACE-R = 68/100; correct IFR = 19; correct DFR < 6,21;

About & Family	<u>Limitation / Difficulties in</u>	
Mario has a Mild Cognitive Impairment diagnosis. He was owner and manager of a bar. He lives with his wife in a large house on the outskirts of the city. His wife is in close contact with him through her mobile phone. They live near their daughter's house and he frequently takes care of his grandchildren. He has a good relationship with his brother.	remembering appointments, driving in unfamiliar places, managing bank transactions, dispensing his own medication	
Health	<u>Disease</u>	<u>Symptoms</u>
Mario suffers from high blood pressure. He is able to move without difficulties and can walk without support. He can carry out the activities of daily living by himself (dressing, toileting, transferring, continence, feeding and bathing). He often forgets to take his medicine and loses personal effects. Mario drives in familiar places and he is able to make small purchases. He can dial a few well-known telephone numbers and performs light daily tasks, such as throwing out the garbage and setting or clearing the table.	high blood pressure	memory deficits
Social	<u>Psychographics</u>	<u>Drugs</u>
Mario spends most of his time taking care of the garden with his brother. He weekly attends autonomously cognitive stimulation activities in a group. He sometimes feels incapable because of his memory problems. He likes social context. Sometimes Mario and his wife go to their beach house.	anxiety in novel situations and during simple problem solving, forgetful	yes <u>Hearing</u> good <u>Eyesight</u> glasses <u>Educational level</u> basic <u>Risks</u> depression
Technology Usage	<u>General attitude towards technology</u>	
He uses a mobile phone. What he likes is watching TV and listening to the radio. He doesn't like computers.	neutral	
	<u>Devices in use</u>	
	Mobile phone, TV, radio	

Figure 1 Real Clinical Case 1

Rosa NERI

Perugia, Italy



MCI diagnosis; Age 82; Educational level = primary school; CDR = 0,5; ADL = 5/6; IADL 5/8; able to perform the TMT A and B; correct MMSE = 24/30; correct ACE-R = 67/100; correct IFR = 16; correct DFR=5,72;

About & Family	Limitation / Difficulties in	
Rosa worked as a seamstress. She has been widowed for ten years. She has two children, who are very attached to her. She lives alone on the lower floor of the son's home in a small town. Both her daughter and her son supervise her medication therapy. She goes shopping accompanied by a member of the family.	perspective memory task, take medication, home tasks	
Health	Disease	Symptoms
Rosa has a Mild Cognitive Impairment diagnosis. She suffers from chronic ischemic heart disease, systemic arterial hypertension and bilateral gonartrosis. She needs prosthesis for hypoacusia. She is independently on the basic activities of daily living (occasional incontinence) but she needs help with banking and major purchases, taking her medication and with all home maintenance tasks. She never took the initiative to get her own driver's license. She accepts her memory problems saying that she is 82 years old (low awareness of memory problems).	amnesic MCI, hypertensive cardiopathy, and osteoarticular pain	memory deficits, pain
Social	Psychographics	Drugs
Rosa appears happy and satisfied with herself. She loves to stay in her courtyard and to converse with the neighbors. She spends most of her time cooking, gardening and sewing. She likes to go outside of home with her family (children and grandchildren).	forgetful	yes
		<u>Hearing</u>
		prosthesis
		<u>Eyesight</u>
		good
		<u>Educational level</u>
		Primary school
		<u>Risks</u>
		General worsening
Technology Usage	General attitude towards technology	
She uses a simple phone and watches the TV	good	
	<u>Devices in use</u>	
	Simple phone and TV	

Figure 2 Real Clinical Case 2

Max HOFER

Vienna, Austria

Age 50; Educational level = apprenticeship; Occupation: metalworker; MCI diagnosis: CDR = 0,5; ADL = 5/6; IADL 5/8; able to perform the TMT A and B; MMSE = 24/30



About & Family	Limitation / Difficulties in	
<p>Max still works as an official at the public transport service. He lives with his wife in an apartment located in the city and they have one son. He regularly leaves the apartment on his own and also does shopping errands, but he might forget some items. He needs help from his wife to organize medication, but he takes the medication by himself.</p> <p>Max' older brother lives in the same city, also diagnosed with MCI.</p>	<p>perspective memory task, take medication</p>	
Health	Disease	Symptoms
<p>Max has a Mild Cognitive Impairment diagnosis. After a trauma in his family, he suffers from depression. He is independent on the basic and instrumental activities of daily living, but needs support from his wife concerning his appointments and intake of the pharmacological therapy. He has problems remembering names and places, has difficulties to connect sub-information and is anxious about unknown situations.</p>	<p>MCI, assured genetic AD diagnosis</p>	<p>memory deficits, disorientation, depression</p>
Social	Psycho-graphics	Drugs
<p>Due to his work, Max has strong social inclusion and he likes being out. However, he fears missing appointments. He likes to play tennis with his friends from work, and once a week he goes to the sauna. He and his wife have close contact with his brother and his sister in law, especially since his brother was diagnosed with MCI too.</p>	<p>forgetful, sad, anxious in novel situations</p>	<p>yes</p> <p><u>Hearing</u></p> <p>good</p> <p><u>Eyesight</u></p> <p>good</p> <p><u>Educational level</u></p> <p>secondary school</p> <p><u>Risks</u></p> <p>depression</p>
Technology Usage	General attitude towards technology	
<p>He is very interested in modern devices and has good technical proficiency.</p>	<p>Very good</p> <p><u>Devices in use</u></p> <p>Smartphone, TV, tablet, PC</p>	

Figure 3 Real Clinical Case 3

Marina EGGER Vienna, Austria

Age 58; Educational level = teacher academy; Occupation: teacher; MCI diagnosis; CDR = 0,5; ADL = 5/6; IADL 6/8; able to perform the TMT A and B; MMSE = 25/30



About & Family	<u>Limitation / Difficulties in</u>	
Marina still works as a teacher of religious education. She is married and has three grown up children. She regularly leaves the apartment on her own, does shopping errands and runs the household. Marina feels abandoned by her family and is affected by them criticizing her forgetfulness. She has a good relationship to her sister.	perspective memory task and remembering appointments	
Health	<u>Disease</u>	<u>Symptoms</u>
Marina has a Mild Cognitive Impairment diagnosis, suffers from hypothyroidism and is depressive. She is independent on the basic and instrumental activities of daily living and organizes and takes her medication by herself. She has problems remembering appointments, difficulties with episodic memory and often repeats herself.	MCI, hypothyroidism	memory deficits, depression
Social	<u>Psychographics</u>	<u>Drugs</u>
Since Marina is still teaching, she has strong social inclusion. She is very close to her sister, who helps her remember appointments by sending text messages. The relationship to her husband and children is tense, which is oppressing for her and worsens her symptoms. Concerning her work, she is afraid of forgetting names of colleagues and students and is anxious of doing complex things, such as statistics.	forgetful, sad	yes <u>Hearing</u> good <u>Eyesight</u> good <u>Educational level</u> teacher academy <u>Risks</u> depression
Technology Usage	<u>General attitude towards technology</u>	
She uses a smartphone, watches TV and works on the computer. Marina is afraid of doing something wrong when using technical equipment.	neutral	
	<u>Devices in use</u>	
	Smartphone, TV, PC	

Figure 4 Real Clinical Case 4

3 Empirical Data and Analysis

3.1 Analysis and Findings design ethnography

Strategies of Remembering

The six informants in Austria use analogue calendars of different sizes (A5, A3, A1) as well as the smart phone (google, images, WhatsApp, text messages) the most. Carers (wife, sister, daughter etc.) complement the list as well as the usage of analogue cribs, notes or post-its that are thrown away after the event, appointment or 'To do' has been completed. The six informants in Italy use analogue family calendars (e.g. with one month per sheet), spatial strategies such as specific drawers, baskets or cupboard areas for storing things, digital wall clocks for date and time as well as carers most frequently. Findings from both countries are summarized in Table 3.

Table 3 Strategies of Remembering Findings from Austria and Italy: Ordered in Categories

Analogue calendars (for wall, table, diary)	12
Smart phone (google, images, WhatsApp, text messages)	8
Analogue notes, notebooks, cribs, post-its	8
Spatial strategies (wall clock, small rooms, basket, drawer, dresser etc.)	7
Carer (wife, sister, etc.)	5
Digital calendars	2
Appointment reminder from clinicians	1
Newspaper to see daily date	1
A set of folders	1
Own head/memory	1

The graph shows the peaks once more:

The Spanish panel of experts remarked that the Italian findings are more similar to the Spanish population rather than the Austrian findings.

Product World

This part of the design ethnography is intended to help the project team understand which technical equipment, informants already use and which products are generally appreciated. Researchers consequently posed the question: *What technical equipment do you use at the moment? What do you like/dislike in them?*

Table 4 Currently used technical products, users in Italy and Austria: ordered in categories and along most frequently mentioned

TV	9
Domestic appliances (kitchen appliances such as toaster, coffee machine, kettle, oven, microwave; cleaning equipment)	7
Computer (laptop or desktop with printer)	6
Smart phone (Photo function, WhatsApp, Internet search	5
Cell phone (no smart phone; text messages and calls)	5
Cordless phone or phone (calls, answering machine)	2
Webcam	1
Tablet	1
Digital camera	1
Car navigator	1
Clock radio	1
Walkman	1
Alarm clock	1

The graph shows the peaks once more:

Domestic appliances (e.g. kitchen appliances such as toaster, coffee machine, kettle, oven; cleaning equipment) were not mentioned at all in the Italian group, while very often in the Austrian group. With the Italian group TVs were mentioned most often. The majority of Austrian users mentioned the computer; three mentioned smart phone usages, while only two in the Italian group. In Spain, the panel of experts agrees that Spanish users would be closer to the results of Italy than those in Austria, arguing that the use of

appliances with built-in technology is low because they generally use more traditional methods than last generation tools.

As an additional area, a second part of the ethnography explores informants' most appreciated objects and thus asked to name five objects/products that they value because of their function and aesthetics, see Table 5.

Table 5 Most valued objects, users in Italy and Austria: ordered in categories and along most frequently mentioned

Memorable objects/souvenirs (paintings, wooden giraffe, glass from Barcelona, picture with soccer star, fan equipment from soccer, glasses, majolica, silver objects, calendar)	11
Furniture (reading lamp, relax chair, sofa "chill-out corner", carpets, kitchen furniture, drawers, dresser)	7
Photographs/Pictures	3
Religious objects (Crucifix, Angel made of ceramics)	2
Sewing machine	2
TV	2
Garden	1
Bicycle	1
My own room	1
Books	1
I like everything (I own)	1
Stuffed animal	1
Antique clock	1
Stick	1
Pant iron	1
Sport Newspaper	1
Curtains	1

The graph shows the peaks once more:

In Spain, the panel of experts agrees that Spanish users would grant greater relevance to objects / souvenirs that allow them to retrieve memories in an accessible way.

In Spain, the panel of experts agrees that Spanish users would grant greater relevance to objects / souvenirs that allow them to retrieve memories in an accessible way.

Diary for a Week

The diary tries to record everyday situations where an intelligent reminder assistance could be useful. Informants have been asked to document one situation a day in which it would have been supportive by describing specific situations such as shopping, doctor's visit, cooking, forgot date, forgot names etc. These situations would be taken as a point of departure for the later development of activity scenarios. See Table 6 for a summary of findings in both countries.

Table 6 Everyday situations where an intelligent reminder system would be appreciated - both user groups (ordered by categories)

Support for new situations (anything could become a challenge in the future)	3
Being at a public place and not knowing why you are there and what you should do	2
Being at a public place and not knowing why you are there and what you should do	2
Cannot find of objects and thinks they have been stolen (food, cutlery, passport)	2
Word finding difficulties	1
Take back tools (at workplace)	1
Cannot find things (for example packing bag for sauna)	1
Forgets what he/she had for lunch	1
Support for cooking	1
Support for shopping (forgot items)	1
Do not get up in time to attend religious celebration	1
Doubts for taking medication, a guide would be helpful	1
A weekly planning could be useful	1
A phone that synchronizes with the blackboard information	1
I am often alone; an audio or video application could be good	1
Fear of being alone	1

The graph shows the peaks once more:

Numbers in these sections are limited by a low participation rate. In Vienna: Two informants in the Viennese groups already stated during the interview that they cannot think of further situations so they will not be able to add anything to this section. One informant did not return the diary, one informant took diary notes and returned it filled out with a few days. Learning from these experiences, the researchers adapted the strategy and used the diary concept during the meeting. Instead of the informants filling out these sections, the researchers took notes. The same strategy was taken with all informants in Perugia, both in Austria and Italy with a higher success rate.

Austrian users seem to name specific wishes connected with their most challenging everyday problems (e.g. word loss) as well as wishes that would enable to continue tasks they appreciated in the past (e.g. cooking). Italian users mentioned 'robots' specifically as humanoid bots, functioning like a buddy. A device featuring a voice was mentioned more often with Austrian users but in general seems to be connected with comfort, by reducing the fear of missing appointments.

In Spain, the panel of experts also agrees that Spanish users would have difficulties in thinking about future situations, with which the ethnographic results of this section would also be adjusted to the Spanish population.

1.1.1 Discussion of Design Research and Points to take to the Design Phase

Strategies of Remembering: Cultural Differences and Essentials

Differences between the two countries: Appointment reminders from doctors or therapists, smart phone usage as a tool (WhatsApp, text messages, images, google etc.) are entirely absent as tools in Italy. The user group in Italy mentioned specific spaces more often (e.g. to store drugs in a special drawer, basket or dresser). Another difference was, that this user group mentioned the usage of newspapers or digital clocks as a means to check the day and date.

The panel of experts indicates that in the Spanish population, the strategies usually used are analogic rather than digitals. Therefore, in this aspect users would also come closer to the Italian than to the Austrian results, noting that

in general terms, the cultural differences between Italy and Spain are less than between Austria and Spain.

An interesting take away for the next phases of Memento Project is the need for the most essential information such as date and time. This information should be prioritized and very easily accessible.

Product World: Towards Continuation

In general ICT is used by all informants to a varying degree. However, the usage seems to be less a matter of cohort or age group (60-70/70-80/80-90) but more a matter of previous usage of technology. One informant in our user group, aged 58 uses a cell phone but no smartphone, whereas informants over 80 did use one. The panel of Spanish experts indicates that they agree with the previously mentioned by the clinical counterparts of Italy and Austria.

An essential take away: simplicity and intuitive usage of the Memento system will enable greater acceptance rates. The system must be able to run on a variety of devices, this way a device that the user is already familiar with, can be chosen.

Valued Objects: Towards Adaption

Findings show a peak for memorable objects/souvenirs and furniture ranging from reading lamp to relax chair. Possible interpretations informed by material culture studies (Miller, 2008; Miller and Parrott, 2009) might be that memorable objects/souvenirs have a strong connection with kin and friends, they take on agency by objectifying leisure time, travelling and not lastly a maybe more promising 'past'. The relatively frequent mentioning of furniture and objects of the home with a tactile quality, might point to heightened appreciation of 'safe' spaces that people are familiar with and do not have to adapt to. In general, we can sum-up that valued objects can take on nearly any form, depending on the social, cultural and economic habitus of a person (Bourdieu, 1984).

For Memento Project we might use this knowledge to give some possibilities for adaption (e.g. if the system works with an avatar "that talks to me", there might be the option to personalize this feature etc.)

The Diary: Everyday a New Challenge Could Turn up

Situations that stand out: the future solution might support people with dementia having difficulties with connecting space and intention. Mentioned situations were, being at a public place and not knowing why you are there and what you should do. Secondly, people with dementia request support for situations where they cannot find things anymore and this they have been stolen, these objects can be as varied as food, cutlery, passport etc.

However, this section showed the great variety of challenges that people with dementia face. The 'unknown challenge' causing insecurity was as a remarkable finding and points to a main feature Memento should cater to: providing a sense of security like a well-known, familiar partner.

The panel of Spanish experts unanimously agreed with this affirmation.

3.2 Analysis and Findings Co-Creation Workshop with Users

To enable an inclusion of people with dementia and their partners in the design process, these use case drafts have been transformed into stories and combined with use case visualizations so that the cases become more tangible and situated.

The goal of the workshop is to share the progress of the project with informants, to provide a platform for the whole user group to meet up and get to know each other, as well as the project team. Informants' work with the use cases supports the international project team, to define meaningful application scenarios and functions for the future solution. This workshop focuses on sharing the work from the cross-disciplinary workshop with the user group and aims at enriching the ten use cases with users and carers' expertise and input. This workshop is carried out in Austria, Italy and Spain. In terms of methodology it combines the principles and techniques of requirements engineering with a generative design research approach, used in participatory and co-creation settings (French et al., 2016; Sanders and Stappers, 2013, 2014; Sanders et al., 2010). In principle, generative design research is an approach to include those people in the active design process that shall be served with a future solution. This is seen as a basic principle to include all design partners' needs, ideas and requirements for the future. Generative tools can take on many different shapes but what they have in

common is they enable prototyping and ideation together with design partners.

In the workshop, participants will be presented with all ten potential use cases first, then small sub-groups worked on three to four scenarios; in small groups the relevance of the scenario and potential adaptations will be discussed. At a second stage, participants will be asked about their preferred interaction with the smart memory system. Users will then choose one of the generative tools present (smart watch, smart phone, smart pen and analogue calendar etc.) or give instructions for new ones.

The co-creation workshop has been carried out in Austria and Italy, its length was two hours each. In Austria six informants (three people with dementia plus their partners) and in Italy five informants (no care givers) participated.

4 List of Requirements

4.1 Functional Requirements

Table 7 Functional Requirements

Category	Requirement	Priority	User	Care-giver
Hardware	hardware should not stigmatize the user	3	x	
Hardware	hardware should look familiar to users	3	x	
Hardware	batteries should last at least one day	2	x	
Hardware	ability to record audio	1	x	
Hardware	ability to retrieve GPS location	2	x	
Hardware	ability to measure stress levels	1	x	
Hardware	ability to playback audio	2	x	
System	permanent internet connection	3	x	
System	There should be a fixed place (e.g. docking station) at the user's home.	3	x	
System	ability to disable hardware buttons	3	x	
Backend	ability to synchronize data on all devices	3		
Software	user interface for caretaker	3		x
Software	user interface for user	3	x	
Software	ability to manage user accounts of patients	3		x
Software	ability to set a home address for a patient	3		x
Software	ability to set an emergency number for a patient	3		x
Software	ability to call for help	2	x	
Software	ability to see the location of a help call	3		x

Software	ability to add calendar entries	3	x	x
Software	ability to remove calendar entries	3	x	x
Software	ability to edit calendar entries	3	x	x
Software	reminder for calendar entries (depending on the location)	3	x	
Software	ability to add notes	3	x	
Software	ability to view notes	3	x	
Software	ability to edit notes	3	x	
Software	ability to add medication schedules	3		x
Software	ability to view medication schedules	3	x	x
Software	ability to edit medication schedules	3		x
Software	ability to add medication	3		x
Software	ability to view medication	3	x	x
Software	ability to edit medication	3		x
Software	reminder for medication intake	3	x	
Software	ability to add lists	3	x	

4.2 Non-Functional Requirements

Table 8 Non-Functional Requirements

Category	Requirement	Priority	User	Care-giver
Hardware	display(s) should be readable in sun light	1	x	
Hardware	devices should resemble memorable tools	3	x	
Hardware	ability to use a pen	3	x	
Hardware	ability to charge batteries wireless	2	x	
Hardware	hardware buttons should be easy to find and press	1	x	
System	secure authentication	3	x	x

Backend	user data should be stored encrypted	3	x	
Backend	user data should be transferred encrypted	3	x	
Software	users should not be able to exit the Memento software	3	x	
Software	operating systems should not display information unrelated to Memento software	3	x	x
Software	no web browser	3	x	
Software	information should be displayed in big letters	3	x	
Software	there should not be a screensaver	1	x	
Software	size of UI elements should be big	2	x	
Software	there should be a feasible distance between UI elements	2	x	
Software	accidental exit should be avoided	3	x	x
Software	no gesture control	1	x	x
Software	icons should indicate the purpose of the UI element	2	x	
Software	font size should be big	3	x	
Software	buttons should be big	3	x	
Software	UI labels should indicate the purpose of the UI element	3	x	
Software	UI elements should be properly distanced from each other	2	x	
Software	there should be arrow keys for UI navigation	1	x	x
Software	the display should not turn off	3	x	
Software	hardware buttons should be easy to find and press	1	x	
Software	terms in foreign languages should not be used	1	x	

Software	technical terms should be avoided in the UI	1	x	
Software	there should be no advertisements	3	x	
Software	the UI should not contain more than 2 colors	1	x	
Software	abbreviations should be avoided	1	x	
Software	acronyms should be avoided	1	x	
Software	splitting tasks in multiple screens should be avoided	2	x	
Software	there should be no modal dialogs in the UI	1	x	

The Spanish panel of experts agrees with the aforementioned. However, they indicate that the questionnaires to be carried out for phase B in Spain must include some specific point to gather information about it.

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