Involving all Stakeholders into the Design of Innovative Domestic Products and Services: the NETCARITY Experience

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Abstract: Within the first year of the NETCARITY project the actual needs and preferences of older adults with respect to the design of domestic technologies have been studied, with the conduction of focus groups, workshops, questionnaires and interviews, prototype testing and contextual inquiries. The three main areas of interest were the approach used to establish a strong stakeholders' network that will provide a good basis to implement AAL products and services, the use of scenarios and personas to elicit user requirements and the use of mock-up experiments to let the users' evaluation feedback and design ideas impact on the iterative design of relevant services and interaction interfaces. The research has been carried out at two pilot-sides: Trento located in Italy and Eindhoven located in the Netherlands. Next step in the project is to perform longitudinal evaluation studies with prototypes installed in real homes to analyse the impact of the developed technology on the routines of daily living.

Keywords: User Centred Design, Smart Home technology, older adults, Ambient Assisted Living, scenario based design, personas, mock-ups

1. Introduction

Recently, a lot of effort has been invested in the research community to explore how IT technologies, and in particular Ambient Assisted Living (AAL) solutions, could promote older adults well-being, thus supporting independent living and a successful aging process. However, the success of AAL solutions greatly depends on a sound design that puts users at the centre of process. Even more than with 'ordinary' technologies, in fact, acceptance by users determine the actual adoption of AAL: no matter how functional a technology is, the elderly will not use it, if they perceive it as intrusive, complex, embarrassing, revealing their limitations, or not relevant to their daily practices [1].

Within the NETCARITY (FP6-IST) project, a multidisciplinary team composed of interaction designers, social scientists, care givers, and a group of motivated elderly people is working on an intensive User Centred Design process of AAL technologies to sustain the feeling of confidence required for aging-in-place. The technical basis for the project relies on distributed sensor networks, actuators for smart control, situational intelligence, and advanced communications and human-machine interfaces. Two real home pilot-sites are used to deploy the User Centred (Inclusive) Design approach, eliciting requirements from, and assessing the impact of developed technology/service with real users.

One pilot-site is located in Italy and the second one in the Netherlands. Trento in Italy is a municipality that lies in a valley that is surrounded by mountains. The municipality is geographically very large and encompasses the town centre as well as many suburbs of extremely varied geographical and population conditions. Various distinctive suburbs still maintain their traditional identity of rural or mountain villages. This configuration will require a greater involvement of all relevant actors and stakeholders.

Eindhoven in the Netherlands is a city in the municipality with the same name. The city is located in the south-east of the Netherlands in the province Noord-Brabant. Eindhoven is the fifth city of The Netherlands with 210.456 inhabitants on January the first of 2008 and the area measures 88,28 square kilometres. Eindhoven, the city as well as the region, is known for its innovative character. Kenniswijk was between 2000 and 2005 an experimental platform for the Eindhoven region where end-users had access to innovative services in the field of computers (mobile) communication and (broadband) internet. At the moment the Eindhoven/Southeast Brabant region is known as Brainport, the hot spot within the top technology region of Southeast Netherlands.

In this paper the activities that have been completed during the first year of the project at the two pilot-sites are described. The three main areas of interest are the approach used to establish a strong stakeholders' network that will provide a good basis to implement AAL products and services, the use of scenarios and personas to elicit user requirements and the use of mock-up experiments to let the users' evaluation feedback and design ideas impact on the iterative design of relevant services and interaction interfaces.

2. User Centred (Inclusive) Design

The achievement of NETCARITY's goals (the design and implementation of useful, usable and acceptable services for the well-being of elderly) has to be grounded on the understanding of the actual needs of the target population, as well as on a clear appreciation of the socio-economic implications of the aging-in-place process. To disentangle these complexities NETCARITY has adopted, right from the beginning of the project, a rigorous user-centred (inclusive) design (UCID) methodology to identify the practical and psychological impact of technology on elders' everyday life and style of interaction.

However, involving old age people greatly challenges the applicability and validity of traditional investigation tools, due to peculiar physiologic, psychological, and ethical issues that enter into play. Aspects that need to be taken into account are for instance: the distress of travelling, sensory and cognitive impairments, low confidence in discussing technological issues, interviews in public/neutral places often don't reveal complete/correct information and in-home observations are precious.

To overcome these difficulties, the UCID revolves around an investigation roadmap based on a strong partnership with stakeholders and on strategies for users' continual involvement that can be summarized by the following directives:

1. Contact local authorities, associations of elderly people, voluntary networks, social operators and cultural services and select the most appropriate stakeholders to be involved in the project. Identify ways of integrating research activities with their existing daily practices;
2. Organize interviews and focus groups with stakeholders to understand the type of currently available services in support of independent living, discuss their work practices and problems, and sketch preliminary user profiles and requirements;
3. After a clear identification of the project technological objectives and constraints, and an accurate sociological analysis of the local communities, identify the relevant features of the users to be involved and plan with stakeholders a viable strategy for users' contact, motivation and continual involvement;

4. Prepare general project presentations for elderly people to be performed in the selected aggregation centres to provide means for understanding, raise interest and curiosity, and bootstrap the person-to-person contact process carried out by stakeholders;
5. Conduct interviews and focus groups with elderly people (possibly in combination with in-home observations) to elicit current life styles, interests, preferences and needs and translate them into preliminary general user requirements;
6. Organize periodic events for returning results to users, discussing with them contradictory data, and rewarding their contribution;
7. Invent preliminary design concepts for the user-home interaction paradigm to inspire the overall scenario-based design;
8. Elaborate "personas", i.e. profiles of fictitious elderly inhabitants of technology augmented homes intended: (i) to provide concreteness to the exploration of user goals, attitudes and stories, and (ii) to facilitate end-users' understanding and identification.
9. Elaborate narrative scenarios describing life scenes supported by technology inspired by the user requirements gathered in steps 2 and 5;
10. Test the verisimilitude and acceptability of personas and narrative scenarios in focus groups with stakeholders, to ensure that stimulus material does not suggest stigmatisation;
11. Use (revised) narrative scenarios in focus groups with elders to help them envisaging potential benefit of AAL in their lives and generate refined user requirements grounded within the project objectives;
12. Revise the use scenarios to address the targeted services and functionalities;
13. Proceed with the actual design of interaction interfaces and services, by means of iterative mock-ups and prototype testing.

In the following paragraphs concrete activities with regard to establishing a stakeholder's network, personas and scenarios and mock-up design are described in more detail.

3. Stakeholders Network

NETCARITY has chosen a more inclusive approach inspired to participatory action research [2] and user centred design, able to stress the relationships between researchers, local community and users. The relationships include cooperation, training and education as well as research activities [3]. Participation is an empowerment and educative process [4] rooted in a collegial relationship that brings local communities into a policy debate, which involves continuing spiral research planning, acting, observing, reflecting and then re-planning and so, once more, around the spiral [5]. Using communication tools with a participatory approach is strongly suggested.

While building the stakeholders' network the aim is to establish an ongoing cooperative relationship with all the stakeholders. A lot of effort has already and will be invested to create long-lasting relationships with stakeholders to make them aware of the potential and benefits of Netcarity and ensure that the developed system and services will be integrated into their company processes or in their homes.

Extra care is taken when establishing relationships with end-users. This is very important since part of the research is conducted in the privacy of their homes. All end-users sign an agreement form before we install products in their homes further on in the project. However, because of the large impact on a person's life, research has started on ethical and privacy aspects.

The stakeholders when building intelligent environments are very divers. They all play a different role in the process and have different preferences and opinions. The challenge is not only to develop concepts that are technically possible and reliable but to create a concept that is compiled, supported and accepted by the large group of stakeholders.

Stakeholders are for instance architects, housing corporations, project developers, electricians, builders, care takers, service suppliers, product suppliers, advising agencies, insurance companies and last but not least the end users.

For the first phase of the Netcarity project the stakeholders that play the most important roles are care takers, service suppliers, local authorities and the end users. These four partners form the local partners that will be involved in the project. In the first phase it is important to establish a strong local network and use that as a base for the rest of the project.

4. Scenarios and Personas

Scenarios are "informal narrative descriptions" [6] showing human activities in a story, as for example in Figure 1. The scenarios are used to describe scenes of life supported by the technology inspired by the user requirements.
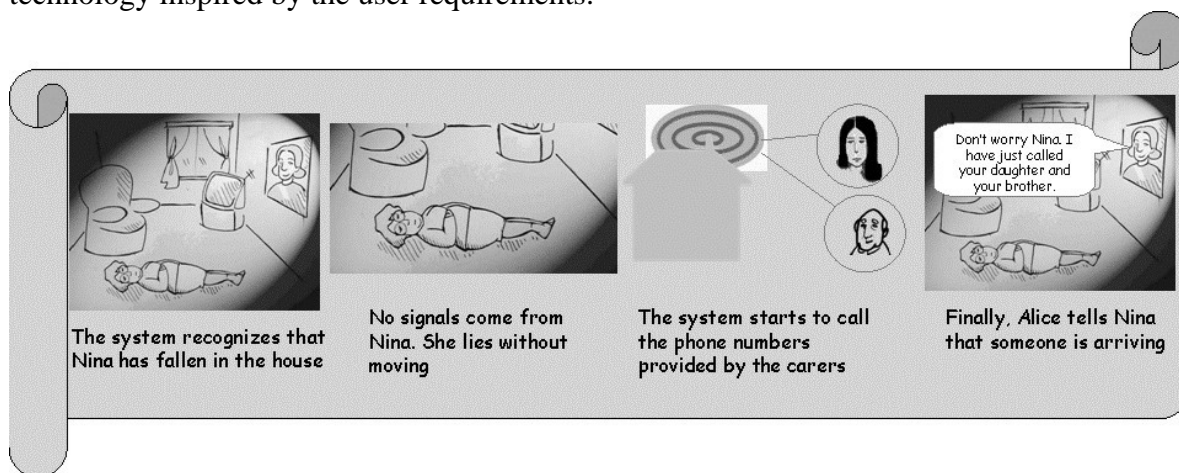

Figure 1: Sample Narrative Scenario in Form of Comics

These stories do not simply describe the usage of a particular technological artefact, but also its role in the activity undertaken by the fictional user. Moreover, they represent a very important communication tool among all the project participants (designers, developers, users, stakeholders). Scenarios-based design however, has some limitations, in particular the fact that scenarios are usually developed around a hypothetical and abstract user whom values, attitudes, beliefs are rarely taken into account in the scenario itself [7]. To overcome this limitation, Cooper suggests the development of scenarios around personas, i.e. characters that "have names, likenesses, clothes, occupations, families, friends, pets, possessions, and so forth. The use of "personas" in scenario-based design makes them more effective and realistic, and capable of creating a stronger focus on users.

Both in Trento and in Eindhoven scenarios including personas were developed in order to investigate and validate the hypothesized services; a major goal was to obtain information about acceptability, understandability and perceived usefulness. The Scenarios addressed the four Netcarity areas, Inclusion, Protection, Assistance and Health, focusing on some specific daily activities which appeared to be problematic or tricky from the previous focus groups and interviews and namely: falling inside the house, managing the access to the house, taking pills, managing loneliness, finding something to do during free time, relating with relatives and peers. Furthermore special attention was paid to the level of detail of the presented technical solution. Enough information was provided to start a discussion but the use of technology wasn't specified too much in the scenario, in order to have a broad discussion about the possible use of technology without the necessity to delve into the details of a specific solution. Figure 2 shows older adults involved in evaluating scenarios.

<table>
<tr><td>*Focusgroup in Trento*</td><td>*Focusgroup in Eindhoven*</td></tr>
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Figure 2: Focus Group Using Scenarios and Personas

The most relevant requirements that have emerged from the investigations conducted in Trento and Eindhoven were summarized. A distinction was made between (i) general requirements on technology (e.g. familiar technology, few functions of daily use with clear meaning, a companion but not a "big brother"), (ii) desiderata on use level services, like inclusion (e.g. motivation to go out and information about social events, nourish social relationships, collaborative sharing of memories and experience), protection, assistance and health (e.g. clear technology boundaries, medicine management, warning about risky events), social and commercial services (e.g. care givers coordination, accompaniment services, easy shopping), and (iii) more detailed requirements for the actual implementation of services and of interaction interfaces (e.g. tangible objects supporting sharing, explicit information about availability, flexible interaction paradigms).

5. Low-Tech Prototyping

Next step in the user-centred design was the development of the first inclusion prototype in Trento, and conducting focus groups and design sessions targeting the services to be installed in the homes of users in Eindhoven. Both activities are targeted at the actual design of interaction interfaces and services.

In Trento the focus is on developing a prototype for e-inclusion. Three dimensions that have been considered crucial for the design of the prototype are: the social sphere (focus on social and psychological issues), the objective sphere (focus on ergonomic and usability issues) and the subjective sphere (focus on emotional experience). The overall design philosophy is "Design for familiarity", consisting of familiarity in interaction modalities, familiarity in the represented domain and familiarity in personal meaningful practices.

Creative brainstorming sessions and an evaluative phase were used to select the features of the final design concept. The resulting final design concept was called MobiTable (a small mobile table with an adjustable surface equipped with a touch screen). The generality and the flexibility of the MobiTable concept allow its enrichment with many of the services envisioned during the early phase of the project and guarantee a gradual and modular development of the services hand-in-hand with the project progress. The services that are momentarily part of the prototype are: a "Social Window" that provides access to the social network for personal and intimate relationships and a "Public Square" based on the metaphor of the place where members of local communities physically meet to share knowledge and participate in social activities.

Once the services were selected and major choices were made about their design, mock-ups were widely used to access with elderly people the pertinence of the design decisions taken. During the first year of project development the following three mock-up testing sessions were conducted:

1. Low-fi mock-ups to test general design choices and functionalities: social window, calendar, notice board;
2. More specific mock-ups to test: ergonomic features of MobiTable, input modalities and interaction modes;
3. Mock-ups to test specific design choices concerning communication services: video-conferencing and textual communication.

Figure 3 shows pictures taken during these three mock-up sessions.

Pen & Paper prototype calendar functionality

Digital prototype with three functionalities

General design choices for digital prototype

User evaluating height

User trying gestures with fingers

User experiencing a video call

Figure 3: Mock-Up Sessions on e-Inclusion Prototype in Trento

In Eindhoven the focus of the research is on functionalities and services that can be integrated in the home environment. Considering the phase of the project that we were in, the decision was made to focus on the non-critical solutions we could present to the participants. These solutions are useful but not life threatening if by any change the Netcarity system doesn't work as it is supposed to. Together with the consortium it was decided to focus on five types of services:

1. Good morning service;
2. Access to information about local activities;
3. Contact with family and acquaintances;
4. Being able to see who is in front of the door;
5. Remotely opening the door.

A cartoon sketching of a potential service was used as stimulus material. But instead of already filling in all the possible solutions, the cartoon was kept at a very basic level: only a short introduction to the service and some triggering questions were presented to the participants. They all received a set of possible answers to the questions asked. Each participant had their own colour to make it possible for us to see the story composed by each participant. Everybody was free to make their own choice, but since the focus group consisted of approximately six people they could also consult each other and discuss about possible other solutions that we defined. Figure 4 displays pictures taken during the focusgroup on services.

Explanation of the procedure   Participants designing their service   Answers given, including remarks

Figure 4: Focusgroup on Services in Eindhoven

The answers given during the focusgroup on services were used to formulate a more concrete scenario for each of the services described. Elders were then asked to envisage the type of interaction device they would prefer to use to access those services in their home environment. To gain insight into their ideas, workshops with elderly people were organised. Goal of the workshop was to design the shell of the device. Participants individually designed their own device, in 2D or 3D, with different types of material that was supplied. From the models that are made by the participants criteria for the interface can be withdrawn. This is partly done in cooperation with the participants: after the models are finished participants are asked to explain why they made certain design choices. Figure 5 displays some of the prototypes made by participants.

"Joystick" as interaction device   Movable screen   Man explaining his design

Figure 5: Workshop on Interaction Device in Eindhoven

6.   Results

Both in Trento and Eindhoven a strong stakeholders' network has been set up. Guidelines on how to select stakeholders were developed. Involving stakeholders early on in the process is important to create concepts that are compiled, supported and accepted by the stakeholders.

The gathering of initial requirements on general services gave a lot of insight into the rationale behind the requirements. We noticed that it is not only important to collect feedback may be even more important to understand the reasoning. This may well be the input we need in the iterative design process to be able to create innovative solutions that nobody has developed before and still comply with the preferences of users. During the interface design sessions we let participants explain their design to gain insight into the rationale. Next steps could also focus on discovering the rationale behind choices. This could mean developing new methods to collect rationale while using the technology in the home environment without being intrusive.

Within the Netcarity project a modular approach is adopted. The generality and flexibility of the MobiTable that was developed during the first year of the project allows its enrichment with many of the services envisioned during the early phase of the project

and guarantee a gradual and modular development of the services hand-in-hand with the project progress. Important to have this approach from the start to be able to implement results from the user centred design process

Mock-ups are a way to rapidly prototype user interfaces through paper or computer-based systems and are extremely useful to acquire early feedback from users about design choices.

The results of the different research methods were translated into user requirements that will be used as input for following design cycles.

7.   Conclusion

Users are most of the time asked to evaluate ideas by others; indeed involving them in the design process and also try to learn from their ideas and solution to existing problems is a big challenge. Within this project we try to find the balance between a) providing too little input that will cause the discussion to end after some general remarks, and b) providing too much input that will bias the creative process of the participants too much towards the ideas formulated by the designers. Initial collected user requirements will be refined during the project with more fine-grained needs and preferences emerging from activities with users.

During the first year of the project the research has been taken place outside the home environment. The next step is to gradually start to transfer the technology developed within the UCID process into the homes of the participants. Within the next research period, both in Eindhoven and in Trento, 20 homes will be equipped with technology. The installation will be gradual so that the participants don't get an overload of functionalities and services. We will report on this process so lessons learned on the installation process can be used for the demonstration phase later on in the project. Special attention will be paid to the development of formal protocols for the experimental setup in order to assure a rigorous compliance with the ethical and effective procedures for the specific technology installation.

Acknowledgment

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