

User requirements for Ambient Assisted Living: Results of the SOPRANO project

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Abstract—“Service-oriented Programmable Smart Environments for Older Europeans” (SOPRANO) is an Integrated Project in the European Commission's 6th Framework Programme. SOPRANO will develop supportive environments for older people based on the concept of “ambient assisted living”, using pervasive ICTs to enable older Europeans to live independently life in their own homes. SOPRANO will not only address the “problems” of old age (e.g. falls, health problems) but will focus on positively enhancing the quality of life of older people. A feature of the Experience and Application Research (E&AR) methodology used in the project is the active and strong involvement of older users throughout the entire R&D process. This paper presents the results of the first phase of user research carried out in SOPRANO in order to determine user requirements for the system.

I. INTRODUCTION

EMERGING information and communication technologies, such as “pervasive computing” and “ubiquitous computing” have considerable potential for enhancing the lives of many older people, by providing additional safety and security, supporting independent living and social participation and improving quality of life. The term “ambient assisted living” (AAL) refers to information and communication technology (ICT) systems that integrate sensors, actuators, smart interfaces, artificial intelligence and communications networks to provide more supportive home environments for frail and disabled older people. A key concern within this work is to move away from technology-push and problem-focused approaches to researching technology and ageing to an approach that is driven by user preferences.

In relation to technology uses, the so called “independent living” or “assisted living” domain today comprises a heterogeneous field of applications. These range from rather simple devices such as intelligent medication dispensers to complex systems such as networked homes. Some are relatively mature and some are still under development.

When it comes to more complex systems in particular, the potentials ICT generally holds in relation to independent living are very likely to be not enough for the sustained success of ICT enabled social and medical support services. Results from previous research for example suggested that organizational, cultural and other non-technological issues come into the play if ICTs are to be successfully introduced into the daily practice of older people. Also in relation to technology itself, up to now all

too often simplistic assumptions have been made in relation to the needs and aspiration of people who's independence is to be supported. There is for instance some evidence that many older people, despite being in need of some help, are cautious of giving stranger insight into and access to their homes. They would probably better accept technology-based help if they had more influence on what information is sent out, to whom and under what circumstances.

At the same time, recent research suggests that a large segment of the growing number of older people in Europe can be offered ICT-enabled support services which considerably improve their quality of life, provided usability of ICT systems can be equally improved. Ambient intelligence and new abilities of software systems to communicate with play a crucial role in relation to this.

Against this background, SOPRANO aims at significantly improving the way users can interact with and take charge of their living environment. The project also takes a leap forward in the way informal carers and professional care personnel can support and assist older people. In that sense, the SOPRANO system is not to act as a traditional “smart home”, passively receiving user commands, nor as pure “remote care”, monitoring user activity to alert outside staff when action is needed. SOPRANO shall instead act as an informed, friendly agent, taking orders, giving advice or reminders and ready to help, and get help, when needed.

II. APPLYING METHODS THAT FIT THE NEEDS AND ABILITIES OF OLDER PEOPLE

Addressing the target group of older people requires methods that perfectly suit this group. SOPRANO does not only want to gain a quick insight in the system usage and user acceptance but also gain understanding of learning effects that are especially important in applications that are used on a daily basis. Standard tests can be for example too tedious, standard questionnaires might not be understood by everyone or expecting new ideas to be understood might be too challenging.

In addition to this in ambient intelligent systems the context of use of a system is much more relevant than in standard office environments. The project needs to develop methods and tools in order to prototype context with users.

Both established and specially developed methods based on the latest Experience & Application Research

(E&AR) approaches are deployed as “innovation enabler”, ensuring that SOPRANO systems fully utilize the potential of technology innovation to meet user needs and gain wide acceptance.

E&AR [1] asks for research, development and design by, with and for users. It also requests research into methods and tools that enable this. This approach is crucial to the development of human-centered ambient intelligent systems. One of the aims of involving users in ambient intelligence R&D processes is to create useful and successful products. Researchers and developers increasingly recognize the need to cross the barriers of disciplines to create products that match the future demands of users. A more multidisciplinary approach to the development process opens up to new possibilities, perspectives and methods. The possibilities and constraints of ambient intelligence are dependent on user evaluations in the context of their everyday lives. E&AR must also consider relevance to social and cultural practices.

SOPRANO follows the E&AR approach not only by involving users from different European countries throughout the whole R&D process but also by developing new methods and tools that not only are adapted to the target group of SOPRANO but also go beyond state-of-the-art approaches by developing new methods and tools.

III. PARTICIPATORY REQUIREMENTS ENGINEERING

Requirements work started with the conduction of an extensive literature review where the primary focus was on gaining a better understanding of physical, psychological and other changes that tend to come with the process of human ageing. This preparatory exercise was to lay the ground for the identification of key challenges to independent living, with a view to identifying options for the provision of an adequate technological response to these.

In a next step, a repository of generic situations potentially threatening older peoples’ independence or quality of life was compiled on the basis of the knowledge gained from the literature, and on the basis of feedback received from those project partners who have experiences in providing support services to older people.

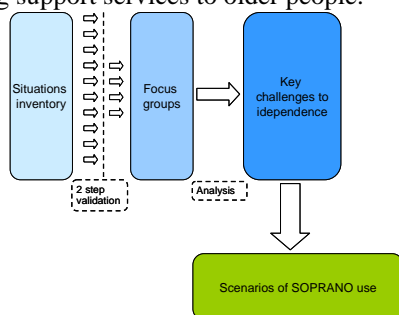


Fig. 1. SOPRANO process of user research

The next step in requirements elicitation focused on involving potential users of the SOPRANO system in order to gather their feedback on a) key challenges to independence/quality of life and b) initial ideas on how technology could be harnessed to better cope with these

challenges. A qualitative approach involved both focus groups and individual interviews. Overall, 14 focus groups with altogether more than 90 users were conducted with older people, informal carers and care professionals in the UK, the Netherlands, Spain and Germany. Individual interviews with older people took place in Germany, Spain and the Netherlands.

IV. DEVELOPMENT OF SOPRANO USE CASES

A number of key challenges to independent living emerged from the user research. Social isolation has profound negative outcomes such as loneliness, depression, boredom, social exclusion and disruption of patterns of daily living. Safety and Security issues that were highlighted include falls, disorientation, control of household equipment. Forgetfulness appears to be a challenge to independence for many and concerns for example taking medication or finding objects in the house. Keeping healthy and active included physical and mental activity, exercise, good nutrition, daily routines and adherence to medications. Community participation and contribution to local community was a priority for some people. Accessing information/keeping up to date was a crucial issue as well as finding help and tradesmen to do little jobs around the home. Getting access to shops and services was problematic for people who have difficulty getting out of the house. Quality management of care provision is an important issue to ensure that the right amount and right quality of care is delivered in people’s homes. Mobility inside and outside the home includes challenges to personal mobility in terms of walking in the neighbourhood and use of public transport. Ambient assisted living has a potential role in all these areas and the results are being used to drive the technological development in the next phase of the SOPRANO project. A set of use cases have been developed for these thematic areas to capture the functional requirements of SOPRANO and describe interactions between users and the system itself. These not only reflect the functionalities of the technical system but also the processes, actions and interaction of the different components of the overall “socio-technical” system within which SOPRANO is embedded.

In each case, delivery of improved services supported by SOPRANO systems was seen as having great potential to increase the quality of life of older people and to support their independence, enabling them to stay in their own home as long as they wish. Ideas for improved services were developed in response to each challenge to independence, taking into account not only features of technology seen as desirable by focus group participants but also their fears or rejection of other features of technology and of action by service providers seen as intrusive or unnecessary.

To see the design problem in SOPRANO as that of designing a technical system to offer new services without reference to the social world within which the person lives would be to miss a great opportunity - and very likely fail. It is therefore a key question how the technical systems

being designed in the SOPRANO project take part in and are embedded in the process of delivering new ICT-based services. Based on these considerations, the technical components under development will explicitly be conceived and designed as part of a socio-technical overall system for delivering (new) ICT-based services to older people. Against this background, a set of initial use cases were developed to effectively capture functional requirements on the technical SOPRANO system by describing interactions between one or more users and the system itself. The use cases not only reflect functionalities of the technical system under design but also the processes, actions and interaction of ‘components’ of the overall socio-technical system – i.e. informal and formal carers, service providers, GPs/hospitals etc. - and the assisted person himself or herself.

The following SOPRANO scenarios of use have been developed:

- “Medication reminding” dealing with how to improve the situation of a person forgetting to take medicine.
- “Open door” dealing with enhancing safety and security at home.
- “Safe”, monitoring activity for signs of problems.
- “Fall”, adjusting care to increasing frailty.
- “Easy to use home automation” demonstrating smart home components supporting independent living.
- “Exercise”, helping older people to recover from hospital on their own.
- “Active”, monitoring signs of problems and supporting good routines.
- “Remembering”, coping with cognitive ageing.
- “In Touch”, combating social isolation
- “Entertained”, countering boredom.

User research also revealed some important horizontal issues that need to be taken into account for system development. Affordability of any kind of support, let it be technology based or not, seems to be a crucial issue for a large part of the participants. Furthermore, trust in technology is a major issue that needs to be taken into account when developing support systems. Many older people seem to not entirely trust technology and thus are not prepared to rely on it. Also computer anxiety and intimidation by technology appears to affect a considerable share of older persons. And many participants expressed a fear that they would possibly break new technology they attempt to learn. More generally, fear of being dependent from technology was commonly mentioned. In such cases people seem to be intolerant of the way technology works and may only tolerate face to face interaction with other humans.

V. NEXT STEPS

With the results shown above the first steps within the user centered design process as implied by ISO 13407 [2] are taken, i.e. (1) understanding and specifying the context of use and (2) collecting and analysing users’ needs and

requirements.

The state of the art approach for involving users throughout the whole R&D process is typically followed by the development of prototypes by experts (see also Figure 2). By doing this, decisions about the conceptual design, i.e. what kind of functions are to be developed and what the interaction should be like, are made by experts. The prototypes, based on those conceptual design ideas, are then evaluated by users. Therefore, the initial design ideas are not based on the mindsets, experiences and mental models of the users but on the experts.

The approach applied in SOPRANO is to change this situation. Instead of having experts leading the development of prototypes, a more user centered design process is to involve users when developing the conceptual design and, later, the prototypes. The idea is that it is not the users who respond to ideas of experts. Experts should listen to the input from older people and respond to their input.

SOPRANO will follow the process presented in Fig. 2, where the project phases from step two, “Specify the user and organizational requirements”, to step three, “Produce prototypes” are driven by the input from users. These project phases will use new methods to allow generating new design solutions and evaluating design solutions derived from the first phases of user involvement. Theatre methods, a new prototyping technique called the Multilevel Prototyping (MLP) and Focused Design Discussions (FDD), in which the use of the newly developed Guardian Angel metaphor helps to overcome a technology centered way of thinking, will be used to include the user in the process of conceptual design of AAL technology.

Theatre methods are able to portray a situation in a very naturalistic and more immediate manner which makes it easier to imagine and to remember the scene. Plays are very suitable for activating memories and emotions of spectators [3]. Theatre plays offer the possibility to enact a kind of play between users and experts and to include prototypes into the play.

The Guardian Angel Approach helps to narrow the idea generation through explicit assumptions about what might be possible with today’s technology. The metaphor will be used so as not to have to explain exactly how information is gathered in the home or exactly how information is given. Participants should overcome a technology centered way of thinking and therefore to be as close to their real needs as possible.

The presentation of MLPs based on Multimedia Mock-ups is a promising way to develop design ideas together with older people and also to get detailed feedback about early-stage prototypes. The overall system as well as individual pieces of the technologies and interfaces can be experienced from general to more specific. That means the MLP approach enables the stepwise integration of more and more concrete technology throughout the project runtime.

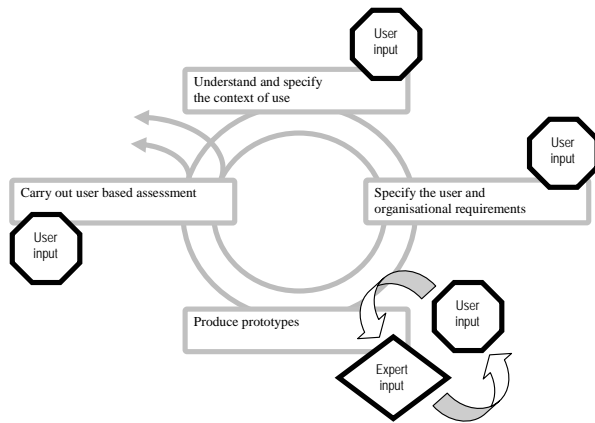


Fig. 2 From specifying requirements to producing prototypes: Proposed change of user involvement compared to stat of the art procedure implied by the User Centered Design Process (ISO 13407) [2]

The greatest challenge is to work together with experts and users in the same design step. This makes it possible to combine knowledge at every moment in the process and is not sequential. For instance, experts are not the only ones who can introduce creativity. Users can also give creative solutions, although maybe on a different level of abstraction. Experiences from previous project phases show a great source of user input in that older people constantly develop solutions for challenges themselves. Those ‘inventions’ can be the kind of input for experts. The challenge in SOPRANO is to develop a research method that will allow this kind of cooperation.

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