

Methods for User Experience Design of AAL Services

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Abstract. This paper presents the approach followed to design the Ambient Assisted Living Services considered for its implementation and validation during PERSONA project. A methodology based on Goal Oriented Design have been followed in iterative cycles to incorporate insights from different stakeholders to the selected services, enriching and refining them through the development of mock-ups and interview assessment.

1 Introduction

PERSONA is an EU VI FP co-funded project which aims at advancing the paradigm of Ambient Intelligence through the harmonization of AAL technologies and concepts for the development of sustainable and affordable solutions for the social inclusion and independent living of Senior Citizens, integrated in a common semantic framework [1].

Its main objective is to develop a scalable open standard technological platform to build a broad range of AAL services to demonstrate and test the concept in real life implementations, assessing their social impact, and establishing the initial business strategy for future deployment of the proposed technologies and services.

To meet its objectives, the project is faced with the following challenges:

- To find solutions and develop AAL Services for social inclusion, for support in daily life activities, for early risk detection, for personal protection from health and environmental risks, for support in mobility.
- To develop a technological platform that allows the seamless and natural access to those services indicated above.
- To create psychologically pleasant and easy-to-use integrated solutions.
- To demonstrate that the solutions found are affordable and sustainable for all the actors and stakeholders involved: elderly citizens, welfare systems, service providers in the AAL market.

The PERSONA technological platform will exploit and incorporate a broad range of relevant technologies which are developed and integrated in the project: AAL system reference architecture, micro- and nano-electronics, embedded systems, Human Machine Interfaces, biosensors, energy generation and control technologies, and intelligent software tools for decision support.

An important measure of success for the project will come from the outcome of the evaluation and validation in trials in Spain, Italy, and Denmark.

In order to assure the success, work has been structured in three lines of activities: AL1 focused on business strategy, AL2 on user experience and AL3 on technology development.

The goal of AL2 is to assure the involvement of end-users and stakeholders in the process of defining, developing and validating AAL Services in such a way that these services will provide a total end-user experience from the start to end, having them embedded in people's daily context of life in, around, and out of home, supporting people's exploration of their own boundaries in relation to their social needs, wish for autonomy, security and mobility.

The User Experience Design approach has been defined as an iterative process combining trends research with user experience methodologies with the aim of enabling continuous end-user insights and feedback along the project lifecycle.

2 Methodology

The User Experience Design methodology followed has been based on the Goal Oriented Design methodology proposed by Alan Cooper in his book "About Face" [2].

In the case of PERSONA, work in UX design has been structured in three sub-phases during the first eighteen months of the project

- Research & Modelling
- Specification
- Assessment

2.1 Research and Modelling Phase

The Research & Modelling phase objective is to gain general knowledge about the domain, to scope out the kind of services that are most valuable when it concerns social inclusion, independence, security and mobility and to analyse the current state and future expectations in these areas.

This will be used to create the "context of use" of the defined AAL services by addressing the following aspects:

- **Target group specification:** It is a predefined list of attributes of targeted users. The goal is to study the target group and identify different typologies depending on the context of use we are focusing and also the particularities of different pilot site countries. It is important to make clear which target group we want to address within each context, because it will determine to a great extent the interaction/design/development of the services to provide in.

- **User profiles:** Is a short of summary of the different types of personalities that we have identified within our target groups, and specifically focuses on the context of everyday life of these personality group. The use of user profiles enables us to look at needs and values of individual people and to define services that better meet these needs. Differing profiles should be presented separately and user profiles are relevant instantiations of a target group for a specific “context of use”.

The next step is to illustrate each AAL Service by means of the definition of Scenarios (“A day in the life of...” tool). Scenarios are a means to consider the contextual information of a person using a solution. In our case, these solutions are each of the AAL Services that will be provided within a “Context of Use”. It helps in identifying why the person is using a particular service, in what environment this person is using it and with whom the person is interacting. Scenarios can present the situation on various levels. In this early stage the focus has to be made in the storyline and the interaction flow between the user and the system providing as result the user experience model.

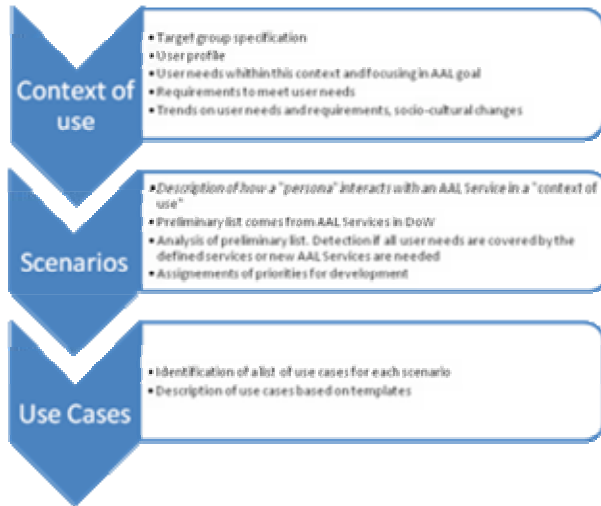


Fig. 1. Research and modelling phase process

2.2 Enrichment Phase

The Enrichment phase aims at improving the service offer by working out the implications of the user experience model resulting in high-level specifications of service directions.

The enrichment cycle delivers answers to the following main questions:

- WHAT services are appropriate to develop?
- WHY are they so important to develop?
- WHO is benefiting from the service?
- WHERE in the context of users' daily life will they access the service?
- HOW will they interact with the service?

The enrichment process consists in three steps:

1. Improve value creation

- Improve storyline based on end user feedback
- Specify the drivers and core values behind the service considering the business aspects
- Review stakeholders involved in the service by specifying the business role and information flow
- Review system capability considering feedback of technical experts

2. Subdivide scenarios into functionalities

- Specify single functionalities drivers based on user needs
- List tasks (use cases) needed to enable functionality

3. Define interaction paradigms for service access and use

- Determine common use cases
- Define key touch points between actor and system
- Specify related assumptions, pre- and post conditions

Templates of specification have been defined taking into account the requirements of the following refinement cycle.

The next step consists of a technical, business and user experience evaluation. Technical analysis is done in order to determine the completeness of the scenarios already described and the level of feasibility according to the technologies to be developed.

Business analysis is done in order to determine the viability of the scenarios and the complexity to develop a business model around each of them. Private and public care sectors have to be considered and the roles need to be defined.

User experience analysis is done to determine if user needs are appropriately addressed and proposed services are desirables from the user perspective as well as from the public and private welfare system. Based on the user experience analysis, scenarios for building mock-ups are selected.

2.3 Refinement Phase

The Refinement phase objective is to reach a solid service specification by refining the services through iterative stakeholders input loops [3].

With the use of mock-ups and interviews, data is collected from the stakeholders and then evaluated. The complete evaluation process is dividing in reporting phase, conclusion phase and scoring and results phase.

The reporting phase involves the capturing of input from the representatives of each of the stakeholders. This information is useful for further service refinement and future reference. The conclusion phase involves the processing of the raw information collected in the reporting phase. Here essential findings and design implications will be gathered. The output from this phase will include the overall summary and conclusions. The scoring and results phase will be necessary for consolidating data from the reporting phase and will run in parallel with the other two phases. Here graphs and

charts will be produced, after processing the data collected. The output is used to rank the AAL services and is included in the summary of the conclusion phase.

For end-users, questionnaires are used to assess, in a standard and formal way, subjective judgments, attitudes, opinions or feelings about the services presented during the interview or focus group. Results allow us to compare between services and rank them from the user interest point of view.

Technical and business relevance is done also by means of questionnaires that will be used by experts as a guide to analyze the main characteristics of the services and assign value to them in order to rank the services. At the end of the process we will have 3 different rankings of services that will allow us to prioritize for development the most promising services in term of user needs, technical challenge and feasibility, and business opportunity and viability.

The aim of the interviews is to gather qualitative insights from stakeholder perspectives. These qualitative insights will:

- Support the process of prioritizing the most attractive services, by providing guidance and ensuring comparability (as much as feasible);
- Support the further development of the services, by validating the concepts and identifying improvement points and strengths.

Because one major purpose of the testing at this stage is to compare the proposed services, it is necessary to provide comparable data. This is best achieved if a common approach is taken to the information gathering, that is, all services/scenarios should be testing using the same methods. We have selected the interview as being the most appropriate method because:

- It provides rich qualitative data
- It can be carried out by non specialists, with some training
- It is not too time consuming

Finally the structure of the interview is important (order of subjects and timing). The general structure of the interview is that it will go from general to very specific issues. To accomplish this, we need to take care of the order of the questions, so the progress will go from general to specific questions. Throughout the interview, the focus of the questions will change from the interviewee to the service/scenario presented. It's important to keep the questions flexible to time, so that it will be possible to cover the basic level of all topics (even if somebody gets ill/tired during the interview).

A more extended overview of the structure of the interviews is given in the table below.

Table 1. Overview of interview structure

End-user Interview		
Section	Subject	Time
Introduction	Setting the scene	10 min.
Storyboard	Walking through and questions	20 min.
Additional mock-ups	Walking through and questions	20 min.
Conclusion	Questions and scoring	10 min.
Closure	Ending the interview	5 min.
Data pre-processing	review the notes	10 min.

During the interviews the end-users are presented with several mock-ups that have been produced to make them experienced the possibilities of the future PERSONA Services.

The types of Mock-ups that have been used are:

- Mock-up in PPT file, eventually including films and animations. It presents the overall description of the Scenario/Service and the benefits intended for the end-user. Some examples of the slides are shown in Figure 2
- Mock-up in tangible format (real mock-up: Wizard of Oz). Some concepts implemented it to show specific details of the Scenario/Service in the form of interactive flash videos or tangible objects.

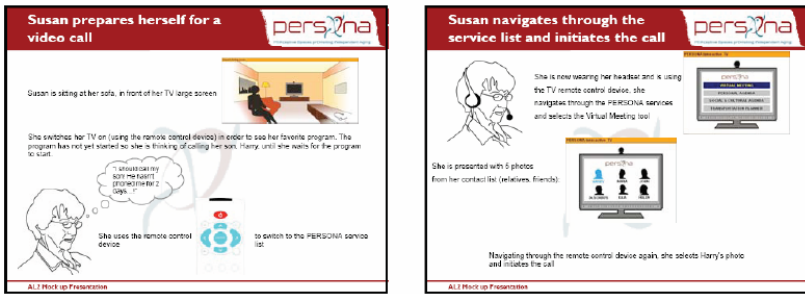


Fig. 2. Example of Storyboard slides

3 Results

3.1 Research and Modelling Phase

According to the analysis made in advance on the services of high potential impact for independent living of senior citizen, four categories of AAL Services have been identified:

- Social integration: services in this category aim at alleviating loneliness & isolation by empowering social contact and sharing of vital experiences
- Daily activities: services in this category aim at improving independence at home by supporting the realization of daily activities
- Safety & protection: services in this category aim at creating safe environment by detecting risk situation occurrence and taking care of them
- Mobility: services in this category aim at supporting life outside home by providing contextualized information and guidance.

During the first iteration, each PERSONA AAL Service category was considered as a “context of use” and following aspects were defined and discussed in detail to compose a matrix related to the four spaces where the services could be provided (body, house, neighbourhood and village):

- User needs: to define the main goal of senior citizens in each of the spaces and for all the categories of services.

- Issues that needs to be taken into account to cover user needs
- AAL Services: to formalize how to address the issues to support the end-users in achieving their goals.

Table 2. Example of matrix for Social integration needs

PERSONA space	Home	Neighbourhood	Village
ADL need	Stay connected with the world, avoid and reduce isolation	Enlarge activity radius, variety of activities, frequency of activities Improve respect and acceptance of elderly	Very similar to Neighbourhood
Issues	<ul style="list-style-type: none"> • Living alone • can not leave the home • no interests and losing motivation to take part 	<ul style="list-style-type: none"> • Old friends are dying • Moving to new environment e.g. nearer to own children, senior residence, sheltered homes and losing old contacts and familiar environment • Fast changes in neighbourhood (traffic, known places, events, volume, size, neighbours interest) 	
AAL services	<ul style="list-style-type: none"> • Virtual meetings and communities • Virtual learning and exercise sessions • State dependent input/output interfaces, communication and information devices 	<ul style="list-style-type: none"> • New friend finder • Managing neighbourhood communities and mixed volunteer and commercial networks • State depended resource management • Synchronising preferences with event transport and care business 	

A preliminary list of scenarios has been generated for each of the contexts based on the AAL Services identified in the DoW. Then during work sessions these services were analyzed together with the contexts of use defined for each pilot site country trying to find out if the needs of the users were covered by these services or new services needed to be defined as well as if there existed significant differences between the pilot sites that needed to be addressed in the definition of the AAL services.

As a result, 16 promising use scenarios were produced as the first description of user requirements, combining our hypothesis based on our experiences in the field as well as real situations of elderly from the pilot sites which have been discussed and analysed in expert workshops.

3.2 Enrichment Phase

The second iteration took place during the enrichment process of the scenarios formerly defined. It started with prioritization of the current 16 scenarios according to its technical relevance and end-user interest. Eight scenarios were selected for

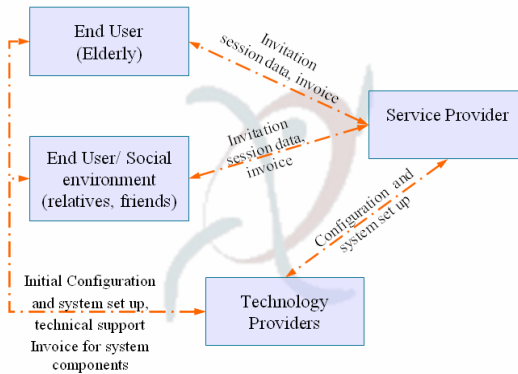


Fig. 3. Example of information flow between stakeholder defined for AAL Service Peer-to-Peer communication

improvement, technical requirements were included in the definition and functionalities that cover user-needs were described together with detailed interaction flows between systems, devices, end-users and other stakeholders.

The result has been used as base to develop mock-ups to be validated by end user collectives to provide feedback of user experience to the AAL service specification.

3.3 Refinement Phase

In the Refinement phase, end-users have been invited to prove service concepts and definitions through mock-up evaluation, providing a comprehensive feedback of user experience to the AAL service specification [4]. Then the User Requirements (UR) extraction process has been carried out, transcribing the requirements of real users derived from the previously performed interviews as well as from Use Cases described in the scenario enrichment process and from a technological point-of-view provided by the partners in charge of developing the services. Additional external sources have been other EU projects, external experts interviews and three workshops have been conducted to discuss the work done and gain more knowledge from a broad set of stakeholders (health and care professionals, legal experts, politics, housing companies etc.). The last step has been to perform a comprehensive prioritization of UR from business, quality of care and technological innovation point of view to deliver the final Service Specification and User Requirement to the development team.

The mock-up evaluation was performed in the three pilot sites, namely Denmark, Italy and Spain.

The recruiting of the volunteers was different in the three countries. In Denmark they used the phone book and dialed numbers asking whether anyone was in the specified age group. In Italy they contacted a social club asking for volunteers. The people interviewed were volunteer members of an association that provides assistance to elderly people. While in Spain the personnel in charge of a centre for elderly people and trainers in a project dedicated to train elderly in the use of Internet, recruited volunteers.

The interviews were carried out in conference or meeting like rooms in all the three countries. TV screens, projectors, laptops were used to present the scenarios, and in Denmark also the interview guide, a paper form to be filled in by each observer at the interviews. In Spain also printed copies of scenarios presentations were used.

Methods for the gathering of data varied. In Denmark they carried out collective or focus group interviews. In Spain they have been conducting individual interviews. While in Italy the first set of interviews were carried out collectively and the second were done individually.

Also the method for registering of data varied. In Denmark each of the observers had been given one person to focus on and register their opinion in the interview guide. This resulted in very different ways and formats to register the answers. In Italy the interviewers took down notes. In Spain the interviews were taped.

The presentations of the scenarios worked efficiently. The overall impression is that respondents were talkative and easy to communicate with. The report from the Italian pilot sites argue that the questionnaires are a bit too long, with the same information being asked for more than once.

Finally, a total of 100 interviews were performed (DK 31, IT 29, ES 40) and the results reported back to the development team with the following documentation:

- One Respondent Report per interview performed. The goal of this report is to capture the interview per respondent. It can help for the further development of the service and in the future it can serve as a reference document. It contains information within a certain category, namely:
 - Final impression / opinion of the concept:
 - Current situation / vision of the future needs
 - First impression of the concept
 - The impact of this concept
 - Willingness to use / pay for this concept
- One Scoring Sheet with data from all the interviews. This is a supportive Excel template that consolidates the concept scoring sheet data from all the interviews and automatically generates graphs.

4 Conclusions

The methodology defined to perform the mock-up assessment presented some problems when trying to put it in practice. Different constrains, such as time, resources or cultural differences, led to alternative implementations of the evaluation process in each of the pilot sites.

The consequence of having different methods used to gather information has produced a certain level of heterogeneity in results, so a careful analysis has been needed to perform comparison between scenarios.

The scenarios and mock-ups presented were well understood and we got very valuable feedback for scenario prioritization and improvement.

The overall evaluation and prioritization has been done taking into account the average percentage of favorable answers in the scoring sheets.

The main factors that have influenced in the valuation of the scenarios have been related to perceived usefulness of the service presented and privacy and security issues. The scenario that was perceived as most intrusive has got the lowest rate while in the high part of the list were the services that presented more perceived benefits to maintain an independent life.

The feedback gathered and the conclusions extracted throughout this mock-up assessment process are being included as user requirements in the service definition and functional specifications.

References

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