User requirements for supporting the accessible design process: Survey & user test results in the framework of VERITAS project

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Abstract

Older and disabled people are not just a tiny minority of the European population: although a lot of principles and standards for accessibility and universal design are available, adopting them during the design process is not always sufficient, since they do not provide developers with explicit guidelines. The aim of VERITAS EU-project is to develop an open framework for providing built-in accessibility support during all design stages. The application fields are: automotive, smart-living spaces, infotainment, healthcare and workplaces. In order to understand designers' needs, a State of Art analysis was undertaken regarding the existing approaches towards physical, cognitive, behavioural and psychological modelling of older and disabled people. A vast survey was carried out to define the industrial needs of designers and developers within the VERITAS project application sectors. It involved 217 questionnaires and 21 interviews. Survey findings point-out a gap in current design and development processes, indicating that accessibility is hardly considered in design due to the lack of knowledge and supportive tools. The VERITAS platform has been tested with designers of the smart-living space domain. Involved users were invited to design the HMI of a new oven and then to evaluate the usefulness, usability, and effectiveness of the VERITAS platform.

Introduction

Funded by European Commission in the Seventh Framework Programme for Accessible and Assistive ICT, VERITAS project (http://veritas-project.eu) aims to provide built-in accessibility support at all stages of realization chain of ICT and not ICT technologies in different fields of application (i.e. automotive, smart-living spaces, infotainment, healthcare and workplaces).

A survey among designers and developers from automotive, smart-living spaces, workplace, e-health and infotainment domains is presented in this paper. The survey was carried-out through interviews and also through web-based questionnaires administered to designers (Dilliman et al., 2001), aiming at better understanding the design and development process of products and services for people with disabilities as well as elderly. The collected data formed the basis to implement appropriate

tools and methodologies in order to increase awareness and needs for accessibility in the five selected areas in the framework of VERITAS project.

Survey: development and results

The survey involved designers of five different domains. In overall 217 designers were asked to fill-in questionnaires about their work, needs, competences and accessibility in design process. Also 21 face-to-face interviews were carried out (Table 1).

Table 12. Carried-out survey

	Automotive	Workplace	Smart living	Infotainment	Health care	Total
Questionnaire	47	40	44	40	46	**217**
Interviews	4	4	4	4	5	**21**
Total per area	**51**	**44**	**48**	**44**	**51**	**238**

Every survey was composed of seven groups of questions:

- *Personal data* **-** age, gender, educational background and field of work.
- *Job and professional knowledge* **-** details about working position, autonomy, team composition, skills and used tools.
- *Design process overall questions* **-** a scheme of a design process is shown and the participant has to describe how much it reflects the design process and the elements normally adopted by him/her. Then participants are asked to give details about the used tools and programming languages.
- *Accessibility* **-** items about usability, accessibility, simulation and virtual design environment.
- *Design, accessibility and your design process* **-** items about familiarity with accessibility guidelines or standards.
- *Accessibility and data collection* **-** items about how end-users may be involved in the design process and in which design phase.
- *Design process. VERITAS approach to design* **-** the traditional approach to design of application for disabled and old people is put in contrast to the design process proposed by VERITAS. Participants were asked which are the differences between the design approach used nowadays by them and the proposed one, which could be the best way to integrate VERITAS functionalities in the tool used by designers and finally in which design phase.

The gathered data deriving from participants' responses were analysed according to the domains in which designers were recruited for the survey. Each item was analysed independently. Descriptive statistical analyses were carried-out.

For each domain involved in VERITAS project (i.e. automotive, workplaces, smart-living spaces, infotainment, healthcare) survey results were analysed in order to highlight findings respect to the State of the Art in design process in the specific field of application. Then similarities and differences trough domains were pointed-out in order to fix designer requirements in the overall process and highlight lacks,

restrictions and opportunities to include a technology aimed at improving accessible design for impaired and elderly people.

Sample details

Most of the participants were between 25 and 35 years old, postgraduate (sometimes PhD) and were engineers or work in the engineering field. The sample was equally spread among junior and senior designers and also with developers per each domain. Many participants had more than 15 years of experience. Participants were recruited within the R&D departments of partners involved in VERITAS project.

Main findings from survey

The most widely used computer coding and programming languages in all domains were: C; C++; C#; PHP, Java and JavaScript. The following table sums up survey results about participants' experience in accessibility, awareness of its meaning and the accessibility testing techniques adopted in their designs or products.

Table 13. Percentage of participants with experience in the different application areas

EXPERIENCE IN	Automotive	Workplace	Smart living	Infotainment	Health care
Usability	57.14%	63.83%	52.17%	80.00%	68.18%
Accessibility	37.14%	63.83%	47.83%	60.00%	68.18%
Simulation	77.14%	51.06%	30.43%	52.00%	45.45%
Virtual environment	62.86%	40.43%	26.09%	44.00%	18.18%

Table 14. Meaning of accessibility

MEANING	Automotive	Workplace	Smart living	Infotainment	Health care
Accessible web site or software applications	31.58%	46.81%	43.48%	65.38%	40.74%
Accessible buildings	36.84%	57.45%	65.22%	19.23%	33.33%
Assistive device	18.42%	34.04%	39.13%	30.77%	18.52%
Elevators	10.53%	12.77%	4.35%	3.85%	0%
Accessible for all	36.84%	59.57%	34.78%	23.08%	25.93%
Design for all	26.32%	44.68%	43.38%	11.54%	33.33%
Platform independent output device (i.e. mobiles, PDA)	10.53%	21.28%	17.39%	30.77%	11.11%
Accessibility of public transport	28.95%	29.79%	21.74%	15.38%	18.52%
Other	2.63%	4.26%	4.35%	0%	3.70%

Table 15. How the developed accessible applications are tested

	Automotive	Workplace	Smart living	Infotainment	Health care
With an accessibility assessment tool	5%	-	-	-	-
Involving the target users	12.5%	29.17%	34.78%	3.7%	48.18%
With expert evaluation	20%	37.5%	13.04%	14.81%	29.63%
With assistive technologies (i.e. screen readers)	-	-	13.04%	-	3.7%
With official guidelines	12.50%	31.5%	17.39%	29.63%	18.52%
With internal checklist	10%	16.67%	4.35%	3.7%	7.41%
Testing by yourself	22.5%	16.67%	13.04%	22.22%	14.81%
We often do not test accessibility	22.5%	14.58%	39.13%	29.63%	14.81%
Other	5%	-	-	-	3.7%

The survey highlighted that designers do not involve target users in the design process because of a lack of opportunities, resources or time. In fact the involvement of disabled or older people in some of the most crucial design phases as requirements collection and testing is rather low.

Consolidated requirements from survey

Designers and developers expressed the need for supporting tools for the design of accessible solutions with advanced features, applications and commands, since they are typically experienced and they work in engineering.

At least two levels of functions should be provided: basic functionalities that should be accessible by anyone and also advanced functions for engineers or skilled users involved in design process. It would be useful to have the chance to switch among several types of visualization (e.g. designer view, programmer or developer view, etc.) and to have resizable instrument boxes or windows. It would be useful to have the chance to create macros and commands. For instance expert users may set macros for testing applications and user interfaces using code directly, in order to allow less expert users to conduct tests using user-friendly or ad-hoc commands. Supporting tools must be able to generate code by creating or moving 2D and 3D graphical objects. Thus designers will use a graphical interface for prototyping and developers will switch to the coding view to test application.

Suggestions on possible guidelines, methods and standards for involving end-users may be given through pop-ups in the supporting tools because older people and

impaired people are rarely involved in the design process. VERITAS tools should indicate when and why it would be better to involve older and impaired people in some phases of the design process, since designers and developers often don't know how to involve beneficiaries in the process phases.

Since designers and developers are hardly aware of accessibility problems and existing solutions, the supporting tools should allow also learning more about usability, accessibility guidelines, standards and problems involved in the design for impaired and elderly. Short guides, glossaries and introduction to Human Factors principles might be helpful tools to be included, as well as domain-specific use cases databases. It would be useful to have a bug report service and an online guideline facility, such as a wiki or/and a forum with a community. The access should be provided directly from the supporting tool. There should be an automatic download of updates of accessibility guidelines, ISO or other recommendations. The software should include the feature to create applications according to certain standards. A menu that allows user to choose the relevant standard by which developer wants to check or also a library with created code should be present. The design supporting tools should indicate in each stage which accessibility requirements have to be considered and how this can be achieved.

Designers and developers required also that tools have not to be more time consuming than traditional design tools. They should be seamlessly integrated in the tools they currently use and in their design process, with no or very little learning effort. Hence the applications developed in VERITAS project should immediately demonstrate clear advantages in using them during the design processes. In this sense, it will be useful to have a VERITAS plug-in, thus extending the scope of the adopted design tools, in order to minimize the learning effort. The supporting tools must be able to import files from other frameworks, such as Adobe framework applications (i.e. format such as .psd, .ai, etc.), CAD files (i.e. format .dwg, .dxf, etc.), files from Visual Studio framework (i.e. format vcproj, .sln, etc.). Designers must have the chance to select the coding language to make his application, choosing from the most used ones (e.g. Java, C, C++, C#, PHP, JavaScript).

Evaluation of the VERITAS platform

During VERITAS project a complete platform of tools for supporting designers and developers of user interfaces and applications in their working activities was finally developed according to project objectives. Tools were designed in order to introduce accessibility issues in design process and thus to guarantee impaired people and elderly usable user interfaces and application.

The tools developed by VERITAS project are conceived for 2D and 3D design environment and also immersive simulation was considered. VERITAS tools have been conceived as independent applications from the framework of applications normally used by designers and developers. During VERITAS platform design process, users requirements collected through the describe surveys have been considered. They provide as output relevant suggestions and data about how to face accessibility issues according to end-user models. VERITAS tools are listed below.

- User Model Generator.
- Model Platform.
- 3D Simulation Editor.
- GUI Simulation Editor.
- Avatar Editor.
- 3D Core Simulation Viewer.
- GUI Core Simulation Viewer.
- Interaction Manager.

First release of VERITAS tools was tested in order to get preliminary feedbacks from users (i.e. designers and developers) and then to allow a redesign and restyle of them. Tools were still prototypes but a preliminary qualitative evaluation of them was considered necessary to improve the following development.

Test methodology

One or more VERITAS tools were tested in pilot sites involved in the project according to domains of application. The aim of evaluation process carried out was to test functionality, usability and users' acceptance of tools in real working context.

Evaluation process consisted of two phases: preparation phase in which researchers establish contact with participants (i.e. designers and developers) and carried out a training session about VERITAS platform; then pilot phase in which tools were tested through direct experiencing by users and data collected through observation, audio-video recording, interviews and questionnaires and also through logging data from execution of defined tasks.

Test execution

This paper focuses on VERITAS tools evaluated by designers and developer working in the smart-living domain.

Test sessions were carried in two pilot site: in Italy at RE:Lab facilities and in Greece at CERTH/HIT facilities. In Italy designers from RE:Lab and from Indesit Company R&D departments were involved. Test sessions involved 11 participants (3 female; 8 male).

Partners involved in Italian test site evaluated tools relevant for designers and developers involved their R&D departments as listed below.

- User Model Generator, for the creation of impaired people or elderly users model.
- GUI Simulation Editor, for the creation of user interaction model with the designed application.
- GUI Core Simulation Viewer, for the simulation of the interaction experienced by impaired people or elderly.

Users were invited to design the HMI of a new oven and then to evaluate the usefulness, usability, and effectiveness of the VERITAS platform. They went through the overall design process focusing of potential adoption of the final target application (i.e. the oven HMI) by impaired people or elderly. They were asked to experience VERITAS tools in order to improve their typical design process. In order to reduce test session duration, test material (e.g. the oven HMI) was prepared.

Most relevant results and suggestions for improvement

Data from questionnaires (i.e. SUS and TAM questionnaires) reported users enjoyed their experience of using tools and they would generally like to use them more often as long as they become available. Someone expressed the belief that they would need to learn a lot before feeling confident using them. Users felt that the tested tools would increase their productivity and effectiveness, but also have some usability issues. The results from all pilot sites are included in this analysis. Data have been analysed and the full set of results is available in VERITAS project deliverables. Results from SUS questionnaires about tools is reported here as example.

Table 16. SUS questionnaire scores for VERITAS tools in smart-living domain

Users	SUS Score
Ver-GEN	54.6
Ver-AE	75.0
VerSed-3D	75.0
VerSim-3D	75.0
VerIM +CFL	65.0
VerSEd-GUI	18.0
VerSim-GUI	84.5

Lessons learned from preliminary evaluation of VERITAS tools mainly focus on test protocol and they aim at providing recommendations in order to improve test procedures and methodology during later evaluations. Several lessons learned and recommendations about the usability and functionality of tools are also summarized.

The preparation phase is an important part of the evaluation. However, based on the feedbacks received from interviews it is clear that participants presented some gaps in their understanding of the tools functionality. This finding brings up the need for even better preparation and possibly explanation of the tools' functionalities. This could be achieved by employing a better documentation that should detail features.

About testing protocol data gathering methods need to be improved in order to ensure data quality. For instance users need to be more encouraged in order to complete feedback forms and questionnaires. Log files need to be gathered consistently and the procedure to collect them need to be improved.

This evaluation provided feedbacks about users' perceptions of their experience of using the VERITAS tools. The overall feedback received with the questionnaires was quite positive and it briefly reported below.

- The majority of the participants revealed they would like to use tools more often once they become available.
- Participants appreciated the tools capability to help them improve their performance and noted they can be effective for their purpose.
- Tools were characterized as useful, providing a good experience to users.
- Usability, however, was not highly rated amongst participants initial perceptions. Tested prototypes were slightly difficult to use and users would need to learn a lot before efficiently using them. The most common need identified was to significantly improve the task workflow of the tools

Conclusions

An extensive survey was undertaken among designers and developers in the field of the automotive, smart-living spaces, workplace, infotainment and healthcare areas in the framework of VERITAS project in order to collect user requirements for the tools that the project is aiming to design. This resulted in a State of the Art analysis of currently existing models and simulation software for the different application areas, with focus on whether they were able to model and simulate disabilities, but also whether they were applicable across the application areas. Moreover the survey among developers and designers in the different application areas also revealed how accessibility is currently addressed and what tools are being used in this process.

Surveys revealed VERITAS project would be offering solutions that would fill a gap in current design and development processes. Accessibility is at present hardly considered in design process due to the lack of knowledge and supportive tools. VERITAS tools are expected to provide aid in the designing phases increasing awareness and knowledge, whether it is by tools themselves or by providing access to direct knowledge or sources.

This report provided also a brief summary of the results derived from the preliminary evaluation sessions of the tool prototypes carried out with developers and designers in the smart-living domain. Feedback obtained from participants using VERITAS tools in real context was reasonably positive with respect to their functionality; nevertheless, several important usability issues were identified and should be taken into consideration for the development of next releases. The quality of the collected data needs to be significantly improved for more in-depth and detailed findings.

New version of VERITAS tools will be released at the end of 2013 and new test sessions will be performed with users (i.e. designer and developers). Also some applications developed by users according to suggestions provided by tools about accessibility will be tested with impaired people and elderly.

References

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