Accessibility and Usability Validation Framework for AAL Interaction Design Process

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The needs

- Ambient Assisted Living as solution to mitigate problems of aging population, however important issues should be addressed
  - Complex services for people which are the less prepared to deal with complex systems → accessibility & usability are a must
  - New modalities of interaction → need tools and techniques to simulate behaviors of physical things
  - High diversity of users’ cognitive, sensorial & physical conditions → need tools and techniques to simulate user behaviors and accessibility capabilities
  - Human Centred Design becomes central → need system design tools that support HCD in all development stages
The needs

• Today accessibility in AAL Service development

  (1)  
  • Lack of skills  
  • Absence of development tools supporting DfA  
  • Manual approach → highly time-consuming endeavour  
  • High work load on the designers

• VAALID starting point → Human Centred Design, Design for all, Universal Design methodologies

  • create applications which are easy to use and are of added value to the intended users
  • draws together the practical, emotional and social aspects of people's experience bringing on the needed innovation that delivers real user benefit

(1) Extracted from COST219ter book “Towards an inclusive future”
The Challenge

• VAALID goal
  • Development of computer-aided supporting tools to be used by Interaction Designers and Usability Engineers at all development stages → VAALID IDE
  • Support the adoption of Human Centered Design Methodology to create AAL solutions (ISO/DIS 9241-210)

Creation of modelling & simulation tools offering HCD support to optimise user interaction design and accessibility and usability validation processes
VAALID approach

Authoring Environment
Allows to virtually create and deploy the components that constitute the interaction structure of an AAL solution.

Simulation Environment
Allows to simulate previously created AAL solutions and to experience AAL scenarios in virtual and augmented reality.

Seamless integration enabling a virtuous cycle of design-deployment-testing, that enhances the conception, tuning and implementation of AAL solutions.
VAALID approach

Primary users
Professionals who are in charge of the conception, design, testing and validation of the human aspects of AAL solutions.

Beneficiaries
Persons that will be the ultimate recipients of the AAL services designed with the support of VAALID.

Secondary Users
- Construction companies
- Interior designers
- Care centers
- Suppliers of interaction devices
- Public Administrations, etc.
VAALID approach

VAALID IDE
AREA OF SUPPORT

VAALID IDE
AE ➔ design context scenarios
AE ➔ define virtual beneficiaries

VAALID IDE
SE ➔ simulate context scenarios
with virtual beneficiaries
SE ➔ simulate context scenarios
with stakeholders

VAALID IDE
AE ➔ design interactions
AE ➔ produce design prototypes
SE ➔ simulate with virtual
beneficiaries
SE ➔ simulate with real
beneficiaries

VAALID IDE
SE ➔ simulate with virtual
beneficiaries
SE ➔ simulate with real
beneficiaries

HCD PROCESS ACTIVITIES

Understand and specify context of use

Specify user requirements

Context scenarios

Evaluate

VAALID IDE
AAL SOLUTION SPECIFICATIONS

AAL SOLUTION REQUIREMENTS

Produce design solutions

Evaluate

AAL SOLUTION

Implement solutions

Evaluate

PROTOTYPES

NOCK-UPS

AAL SOLUTION

USER MODELS/USER PROFILES

CONTEXT SCENARIOS

Analyze

Test

Design

Experience
VAALID project foreseen results
VAALID project foreseen results

- VAALID Modelling Framework
  - Models to describe relationships between different domains
  - Integration of dynamics in execution time (service lifecycle)
- Tools for model instantiation → Authoring tools
  - Environment model builder
  - User model builder
  - AAL service compositor
- 3D simulation technology for interacting with the users
  - Immersive tool: integration and use of *Instant Reality*
  - New 3D interaction devices (Wheelchair)
VAALID project foreseen results

Authoring Environment

It groups the development tools that allow the designer to define and describe the individual elements that intervene in the AAL solution.

- **AAL Service Interaction mode**
  interaction between the user and the AAL solution

- **Environment model**
  pervasive technology within a real physical ambient

- **User Behaviour Model**
  relevant characteristics of the target user group
User model builder

Tool devoted to identify and describe the relevant characteristics of the target users

- WHO “International Classification of Functioning, Disability and Health (ICF)”
- ETSI EG 202 116

Designer can define as many user interaction profiles as needed to address the whole range of requirements from target populations

- Virtual version of a real beneficiary
- Set of models to keep user needs at the centre of design decision
Environment model builder

Tool to provide the designer with the capability of defining the environment in which the AAL solution will take place

- Physical place → VRML models
- Objects placed (i.e. sensors, actuators, interaction devices…)

It handles two types of behaviour:

- Graphically represented in virtual reality during simulation → 3D scene file
- Resulting from interaction between system and user → workflows
AAL Service compositior

Tool for creating the workflow of the AAL service by defining the AAL Service Interaction model.

It receives as input the environment model and the user model and permits the designer the establishment of the links and accessibility capabilities between the different elements of the scene.

Objective is to build the functionality and behaviour of the desired real service.
VAALID project foreseen results

Simulation Environment

It provides an immersive virtual environment that allow seniors to experience the living in an Ambient Intelligence environment.

It provides the functionalities to test the accessibility capabilities of the different elements interacting within the AAL solution.

- **Simulation control panel**
  Main interface to set up and run simulations.

- **3D simulation browser**
  Render engine for the 3D scenes.

- **Living lab verifier**
  Allow integration of real devices and/or developed components of the AAL Solution into the VAALID SE.
Simulation control panel

Tool to allow the designer to select the configuration parameters for the simulation, the control of the simulation execution, the activation of events during the simulation, and the analysis of results.

Different levels of simulation depending on the phase of HCD process:

- Accessibility constraints verification
- Workflows verification
- AAL Service simulation preview
- AAL Service simulation with virtual beneficiaries as well as with real beneficiaries.
VAALID project foreseen results

3D Simulation browser

It is the render engine for the 3D scenes.

Beneficiary is immersed on it and allowed to interact with the environment and the representation of the service that runs on it.

Based in the development of the Fraunhofer Institute for Computer Graphics Research IGD called InstantReality

It can be presented from a simple screen to a virtual reality Cave.
VAALID project foreseen results

Living lab verifier

It allows the interconnection of real devices and already developed software components to the SE.

It can be used to test the simulation of the AAL solution in a real environment, using real interactions devices.
Conclusions

- Central idea is to create an AAL solution virtually first and then refine this virtual solution with beneficiaries and other stakeholders before turning the prototypes physical.

- VAALID intend to help to bridge the gap between the planning phase of AAL solutions and their testing and evaluation in reality
  - Possibility of early detection of potentially costly flaws,
  - Faster decision making, due to the reduction of the time spent in the design-deployment-testing loop
  - Improving the research of innovative solutions, through the conduction of efficient “what-if” analysis
  - Potential to address the needs of a vast number of senior citizens’ categories
  - Management of new types of information not achievable with traditional means
Thank you!

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