Biomed Tech 2013; 58 (Suppl. 1) © 2013 by Walter de Gruyter · Berlin · Boston. DOI 10.1515/bmt-2013-4239

A LABORATORY FOR AAL APPLICATIONS

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Abstract: *For development, demonstration and testing of Ambient Assisted Living (AAL) applications a research laboratory was set up. It consists of three rooms, where the central room provides four areas (kitchen, living room, eating, sleeping) and is furnished in a way similar to real home settings. The concept and methodological approaches are described and discussed. First experiences from usage of the laboratory in the framework of concrete AAL projects are described.*

Keywords: *AAL, living lab, usability, user centred design, smart home*

Introduction

When the novel AAL (Ambient Assisted Living) approach first entered the stage in the beginning of the third millennium our institute already had a long term tradition in research into pragmatic assistive technologies solutions for disabled and older persons.

Close connection to user needs and in-depth understanding of requirements call for pragmatic and efficient design, development and evaluation phases under near to real life situations together with users and experts. The integration of the home environment into the solution within AAL and more recently the upcoming trend towards assistive robotics makes testing on the workbench no longer a sufficient option. AAL solutions require both sufficient space for the various equipment and open space for realistic movement scenarios [1], [2].

Based on these experiences an AAL laboratory for use in research projects was set up at our institute. The approach and aims of the laboratory are described in this paper.

Aims and Approach

Intended use scenarios of our AAL laboratory are:

Expert interviews and small scale focus groups: can be organised in a setting near to real home environments in order to demonstrate prototypes or to explore design concepts.

Demonstrating novel prototypes: For demonstration purpose the AAL laboratory allows to give live presentations or to pre-record prototype presentations in a near to real life setting [3]. For potential participants of upcoming real life trials the laboratory can be used to show what is planned to be installed at their private homes.

User tests: New prototypes can be put into controlled usability and acceptance tests in a reserved environment and in a setting which increases probability that test subjects feel comfortable with.

Technical pre-tests: of prototypes before deploying in field trials allows to judge whether or not quality and reliability of new prototype systems are sufficient for real life trials (e.g. at older persons' homes).

Collecting activity data: Monitoring activity and user behaviour is most fruitful in real settings but before this a controlled pilot trial in an AAL laboratory allows fine tuning of the prototypes and collection of training data [3-6].

Long term installation: Some research prototypes may benefit from the possibility of long term installation in the AAL laboratory.

Figure 1: The early AAL laboratory used for trials with Robosoft's Kompai robot [4]

Design of AAL Lab

The Institute of Design & Assessment of Technology of the Vienna University of Technology does also HCI research in general, investigations in cooperative computer supported work and multidisciplinary design, all relevant for development of AAL core technologies. Thus, while designing the AAL laboratory, it was important to allow both installation of existing home automation, health assessment or personal alarms as well as new add-on installations of being developed prototype systems from various ongoing projects as well as the necessary equipment for control and monitoring. The set-up of the AAL laboratory needs to be flexible, thus possibilities to hide technology wherever possible were created (by providing hidden space for needed technology to control, monitor and record the systems under test).

The AAL laboratory consists of three rooms, a central primary room with four areas (kitchen, living room with TV, eating with table and chairs, sleeping with bed) which are furnished in a way similar to real home set-

tings, the adjacent hallway and (part of) an additional room for supervising tests and as place for manoeuvres of the assistive robots used in several projects.
Special curtains mounted at the windows allow dimming the brightness level down to create dark environments as useful for demonstrating and testing night scenarios (e.g. automatic night light solutions when user leaves his/her bed and goes to rest room).
Most of the laboratory room was refurnished, technical equipment was partly hidden by integrated solutions, the kitchen area is fully functioning (with fresh water and sewer). A suspended ceiling was mounted hiding the original office ceiling and allowing for quick adoption of customized installation of lighting and sensors. A comfortable home like perception of the room was created.

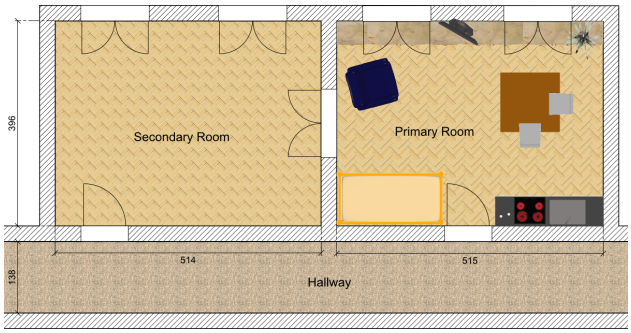

Figure 2: AAL laboratory's central primary room with areas for cooking, eating, living, sleeping and two adjacent rooms (secondary room and hallway)

At the moment the one way mirrors to the observation room as known from usability labs are not yet implemented. This was decided as our current research methodology is much more oriented on co-designing approach (i.e. user and researcher are sharing some context) than on traditional usability lab approaches. Further on, detailed video surveillance can serve the same purpose.
In the current implementation stage the following modules are installed:
Entrance door with door opener: AAL sensors allow knowing if the user is at home. A crucial role (e.g. for recognising if persons are leaving or entering their home) plays the entrance door, which is equipped with a binary door contact sensor, a movement sensor and a remote controlled automatic door opener device from Austrian company Abotic [7].
Kitchen area with stove monitoring: The kitchen block, fridge and the hotplates are monitored by movement and contact sensors. Heat and current sensors let the system know when plates are still hot or turned on. Actuators optionally allow turning the stove off.
Adjustable bed: A motorised bed allows to adjust the height and other parameters of the bed to meet the users' needs (e.g. when standing up from the bed). Movement and pressure sensors detect if the user is in the bed or getting up.
TV: A TV set allows simulating watching TV and can also be used as part of the user interface.
Adjustable chair with standing up support: can be steered by remote control and reduces the needed effort for standing up.
(Light) actuators: the lights in the main areas and selected mains powered appliances can be remote controlled. The installation can be altered quickly in order to provide different layouts of room lighting.
Adjacent rooms and free space: scenarios where the user or robot moves from one room to another, within a single room as well as robot and user moving in the same space can be tested.

Table 1: Description of main areas in the AAL laboratory.

Areas	Description
Kitchen	Cooking plate, sink, micro wave oven, drawers, dish washing machine, fridge
Sleeping	Height adjustable motorised bed, bedside table, night light, light
Living	Motorised chair with standing up support, TV set, light
Entrance	Entrance door with door opener and binary sensor – optionally a door bell
Eating/Table	Table with standard chairs, light
Hallway	Entrance door
Secondary room	e.g. simulating restroom, or observation

Preliminary Experiences

After the initial setup of the laboratory first research activities were carried out, among them: trials with stationary touch screen devices [8], testing and demonstration of assistive robot systems and Human Robot Interaction, e.g. for Kompai (Fig.1) [4] and Hobbit [3] and long term trials of three families of wireless sensor and actuators (EnOcean, HomeMatic, eHome [6]) to compare performance.
The lab is still under construction but it already proved to be very useful when it comes to interaction between human and assistive technology in near real life settings.

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