

# i2home—Towards a Universal Home Environment for the Elderly and Disabled

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We present the EU-funded project *i2home*, aiming at the implementation of an intuitive ambient intelligence home based on a Universal Design approach, and specifically tailored for elderly and disabled persons. We describe how the combination of user-centred design and an open industry standard provide an excellent basis for design-for-all interface technology.

## 1 Introduction

Despite the last decade's research and new insights into human-machine communication, much of today's technology is too complicated to use, e.g., [6]. This is true for consumer electronics as well as household devices—much of the cutting-edge products do not fit in an every-day environment for every-day users. Current home automation solutions are for technophile users. The lack of intuitive or even understandable interaction concepts actually opens up the market for profitable business companies whose business model is centered around the idea of helping people out as they fail in installing or use newly bought computerized technology. For elderly and disabled persons the situation is even worse. At the same time, these people form exactly the user group that could and should profit the most from modern technology.

*i2home*<sup>1</sup>, a EU-funded project, has as its main goal to develop technology for elderly and persons with mild cognitively impairments that supports them in their daily life in their digital home. Rather than developing interface technology for a few, one of the project's main allegations is design-for-all. This is further underpinned by the methodology chosen: the project is build around the user-centred design (henceforth UCD) paradigm. One of the main ideas with UCD is to include the users of the technology right from the start. In fact, their needs and requirements are the driving force behind the development of the technology.

Some of the main obstacles for possibly remotely managing the digital home in a convenient way are that remote control devices usually are device oriented, device dependent and tied to specific target devices. Therefore, the project implements the *Universal Remote Console* (URC) standard [3, 8]. This approach makes it possible to develop user interfaces that are generic, individually adaptable and allows for controlling multiple devices seamlessly, i.e., in one coherent user interface.

The *i2home* consortium consists of nine partners from five countries<sup>2</sup> and brings a wide variety of experiences, ranging from definition and implementation of open standards over industrial software development to contact with target users etc.

<sup>1</sup>See <http://www.i2home.org>, starting date Sept 2006–Aug 2009

<sup>2</sup>The partners are Sweden: Hjälpmedelsinstitutet (HI), Czech Republic: Charles Technical University (CTU), Portugal: Metcube (MET), Spain: VICOMTech (VT) and INGEMA (ING), Germany: DFKI GmbH (coordination), ZGDV e.V., Access Technologies Group (ATG), Siemens C-Lab (SIS).

## 2 Project Design

The *i2home* project has been designed around the user-centred design (UCD) approach [4]. In UCD, the needs and limitations of the target users are the driving force for the development of the technology. In figure 1, the four phases of user-centred design are depicted. In its first phase, the future users of the system get interviewed and, based on their situation, general characteristics (see section 3), personas [2] and corresponding scenarios are constructed. The result has been compiled into two deliverables [1, 5]. Phase two contains the actual implementation including evaluation of mockups and pre-version of the system or parts thereof. Also in this part, the participants are included. Next, tests with the real system are performed in the participant's daily environment, e.g., day-care center. Finally, the outcome of the tests are evaluated and—most importantly—fed into the UCD cycle again. In *i2home*, the UCD cycle is executed three times, each time with a more elaborate system including more interaction features and more targets (see below).

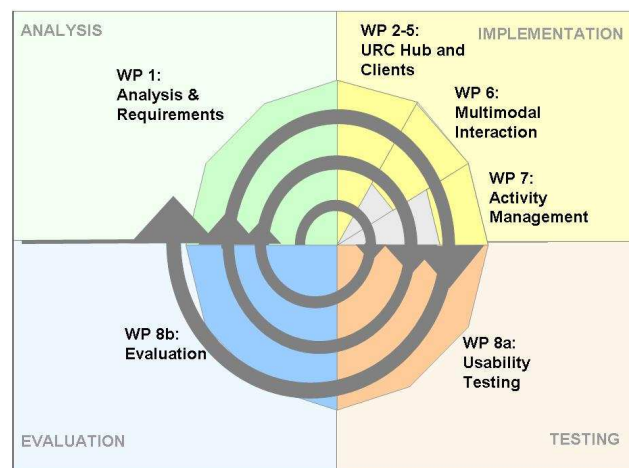


Figure 1: The four phases of user-centered design: Analysis, Implementation, Testing and Evaluation. For each phase, the corresponding work packages are indicated.

The work described has been divided into nine distinct work packages. As depicted in figure 1, each work package is part of one of the four phases of the UCD methodology. Orthogonal to these work packages, a tenth one is devoted to project

management.

**Participants** In *i2home*, the participants are recruited and supervised by four different partners where each partner is focusing on slightly different participants. HI brings young active persons with brain damages due to, e.g., car accidents, CTU elderly active persons and care givers, ING elderly cognitive disabled persons (e.g., Alzheimer's disease) with either relatives and/or care givers. Finally, SIS have contact with elderly, partially-sighted persons.

## 2.1 The Technology

*i2home* implements the ISO/IEC FDIS 24752 Standard *Universal Remote Console* (URC), see [3, 8], an open standard for the digital home. Some of the main advantages with this approach over other (e.g., UPnP and CECED) are that it decouples networking code from interface code and thus facilitates pluggable user interfaces. It embraces present prominent standards and even allows for controlling several devices at the same time. The latter is very important since much action in the digital home consists of the manipulation of more than a single device. Take for instance the task of playing a DVD: here, TV and DVD player have to be switched on. Perhaps even the switched-on radio should be turned off.

The *i2home* system architecture is based on the following basic concepts, see [8] for more details:

- **Universal Control HUB (UCH)** a gateway-based architecture for implementing the URC framework. It mediates communication between controllers and targets.
- **Controller** any device for interacting with the digital home. Examples are TV or a cell phone. In what follows, a controller is called a *console* that thus supports bi-directional communication.
- **Target** any device that should be manipulated and/or monitored. Examples are fridge, hood, lamps, TV and HVAC.
- **Resource Server** an available service for downloading your favourite user interface. The framework foresees alternative user interfaces meaning that in principle any vendor can offer their user interfaces over the Internet.

Figure 2 depicts a possible configuration including the devices foreseen in the first prototype. There, the controller consists of a flash-based user interface running on a PDA that controls three targets, see below.

The advantage with this approach is that we can pursue the same interaction style for all targets. Also, it allows for a great flexibility to utilize a controller suitable for the user's needs.

**The First Demonstrator** Simultaneously to the interviews (see below), a selection of appliances for the first demonstrator was done. We will include an HVAC<sup>3</sup>, a TV, a calendar and an EPG service. In later stages of the project, we are planning to include other appliances based on the CECED and UPnP standards. Examples are fridge, stove, hood, lamps, heating, multimedia center, telephone etc.

To conclude, *i2home* implements a complete ambient intelligence system—the *i2home* system—including a HUB, inclusion

<sup>3</sup>HVAC = Heating, Ventilation, Air Conditioning - see <http://www.serve-home.com>

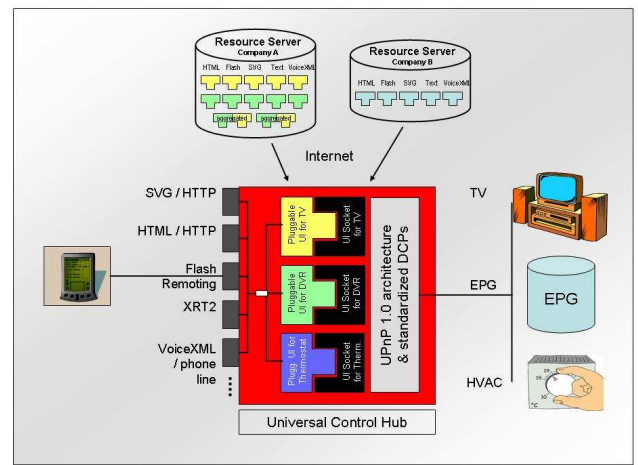


Figure 2: The Universal Control HUB architecture including the devices TV, EPG and HVAC controlled from a PDA.

of prototypical targets and different controllers based on different technology, e.g., flash, multimodal interaction [7] etc.

## 3 Scenarios and Personas

At project start, we invited care givers and care recipients interested in the project to contribute with interviews and testing. Based on these interviews, we have constructed for each user group general characteristics, personas and scenarios, including not just the participants but also additional factors, such as, relatives associated and/or living together with the participant.

**Interviews** During the first UCD cycle, all user partners have performed interviews with volunteer care givers and/or participants. The CTU participants are in total 13 elderly active participants. ING have interviewed in total 20 participants consisting of 10 professional and 10 family caregivers. ING participants were not interviewed, since they are not able to verbalize their needs. Instead, the experience and knowledge of their caregivers have been used. HI has 10 participants consisting of 7 care recipients and 3 participants with mild cognitive disabilities. Finally, SIS has interviewed in total 5 partially-blind care recipients. SIS has worked with partially-blind people since more than ten years. Also, some of the SIS researchers are personally affected and thus contribute with their own experience and expertise.

**Interview Result** The goal of the interviews has been to be able to distill a set of requirements for the *i2home* system. At least the following factors have shown to be important for the design of the *i2home* system:

- Reduced ability to memorize
- Decreased capability of problem solving
- Lack of attention
- Problems with reading, linguistic, verbal and visual comprehension
- Impaired executive functions, such as, plan making, structuring, carrying out activities

For sensory-disabled persons, there are additional requirements on the system, such as,

- The console has to include speech synthesis/screen reader software
- Its display has to be a high-contrast color display
- The console should include vibration to indicate events

**Personas** For each partner, several general descriptions and personas have been constructed bearing the typical properties of the interviewed participants, see [1]. Below is an excerpt of the general characteristics:

- **Characteristics** active
- **Age** 65–70
- **Other**
  - Shares household with his spouse
  - Needs to be active: Need to feel that he/she is up-to-date with state-of-art; has some work commitment; travels; . . .
  - Health issues: The issues make him feel old; irritated by being ill; . . .
  - Overlooking his aging: Afraid of dependence on care giver

From the general descriptions we derive *personas*, i. e., concrete instantiations of the general schema. Based on the interviews, general descriptions and personas, a set of *scenarios* from the daily life of the participants have been constructed. The scenarios contain situations where the *i2home* system assists the participants in doing every-day activities:

**Arnöst** (68) is a skilled computer user who lives with his wife in a flat equipped with the *i2home* system. He is interested in new technology and is trying to keep himself informed. However, he is not regarding himself as a guru. Recently, he had some health problems and his vision is deteriorating. He controls his home with a PDA. He is woken up by the alarm clock with the radio playing his favorite (Czech) radio station “Vltava”. In Arnöst’s *i2home* system, the alarm clock and radio have been integrated into the PDA. . . . The PDA also functions as a remote control for the TV. Here, Arnöst’s favorite channels are prominently positioned on the TV manipulation screen. The TV user interface contains just his favorite channels, on/off and volume control. All other features, such as text-TV, changing of color etc. are not visible to him since he does not need them nor is he interested. An important feature of Arnöst’s console is the calendar. Here he has entered important events ranging from waking up over reminding him about favorite broadcasts to taking his medicine. . . . Arnöst’s user interface is partly equipped with icons instead of text for the main applications. Where necessary, the text is large due to his sight problems. He can manipulate the interface with the stylus and not only with his fingers. He does not want to use voice control.

## 4 Conclusion

We have presented the *i2home* project, an EU-funded project aiming at developing ambient intelligence technology for elderly and disabled persons in the digital home. We do this by implementing the evolving open ISO/IEC FDIS 24752 standard called the *Universal Remote Console* standard [3]. The project is built around the user-centred design paradigm thus letting the requirements and needs of the user drive the development and design of our technology. Instead of explicit modelling the

cognitive state of a user in the running system, interviews and testing will affect the general design of the user interface and the possibility to configure the system.

At the time of writing the first phase, the requirement phase, has been closed and we have identified some important characteristics of a user interface for our target users, see [1, 5].

Next steps include the implementation of URC technology, evaluation of user interfaces and, finally, the real evaluation with the real system.

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