Middleware Architecture for Users Interfaces in Ambient Intelligent supporting Independent Living

J.B. Montalvá, A. Rodríguez, E. Conde, E. Gaeta, M.T. Arredondo

Life Supporting Technologies
ETSI Telecomunicación
Universidad Politécnica de Madrid
jmontalva@lst.tfo.upm.es

Abstract

European population is aging and the current social and health care models will be soon unable to cope with this expected demographic situation. The increased demands on quality services make necessary a change of mind in the way these services are going to be provided in a near future

Disabled and elderly people are two groups that can be specially benefited by the creation of appropriate environments where they can control and access to devices and services in an adapted and personalized way. The Ambient intelligence technological framework and the use of standardized interaction elements are two technologies that will be relevant in the above mentioned change.

This paper presents a new architecture for the development of customized users interfaces adequate to promote the independent living of elderly and disabled people within the Ambient Intelligence paradigm.

1. Introduction

According to the European Statistics Office, between the 10% and 15% of the European population are over 60 years old, and it is expected that this rate increases in the next years. Besides, there is a remarkable relation between aging and disability: above the 30% of the population over 60 years old has some type of disability [1].

The significant expected increases in public spending related to pension, health and long-term care costs make necessary the movement of more social and care services to the home environment. Besides, recent studies on social issues and dependency show the benefits of continuing living at home for people with disabilities or aged and it is also well known that most of them prefer to stay at their own home rather than moving to senior communities or moving in with their relatives [2].

The development of new ICT technologies, like Ambient Intelligence (AmI), can help to create adequate environments so that the claimed and necessary Independent Living can be achieved.

The adoption of standardized architectures to provide optimal user interfaces, adapted both to the users capabilities (hearing, sight, movement, etc.) and preferences and to the specific situations of use (noise, light, etc.), will be one of the main elements that will assure the practical success of this new technological paradigm.

2. AmI and Independent Living

"Ambient Intelligence (AmI) refers to an exciting new paradigm in information technology, in which people are empowered through a digital environment that is aware of their presence and context, and is sensitive, adaptive, and responsive to their needs, habits, gestures and emotions [3]".

The uncountable services and products that can be imagined by means of this new digital world imply numerous new possibilities to improve the quality of life of the citizens. Therefore, new interaction modalities to control devices from different locations and new ways to access services will be feasible. However, the close user interaction AmI implies will

require special care in the development of interaction systems and modalities, that is, in the design of the user interfaces.

Therefore, AmI can offer uncountable benefits to improve the quality of life of the users, especially for those with special need (elderly and disabled people). However, important challenges will need to be faced. The proliferation of new and more complex ways of interactions could leave out the necessity of an Universal Access [4], that is, the accessibility and usability of information technologies by anyone at any place and at any time.

The Independent Living movement – worldwide philosophy which works for the self-determination, self-respect and equal opportunities of people with disabilities [5] – agrees with the necessity of the above mentioned Universal Access, the equal access and participation of people in society, whatever impairment they may have.

Different development methodologies such as “Design for All” will enable the Universal Access in AmI environments. By Designing for All, users are involved in the definition of the products from the beginning to the last manufacture processes. The participation of all kind of users, with or without disabilities, in the design process ensures the accessibility and usability of the products which follows out the motto of the Independent Living movement: “Nothing about us without us”.

2. Objectives

This paper presents a new architecture for the development of customized users interfaces adequate to promote de independent living of elderly and disabled people within the Ambient Intelligence paradigm.

The principal objectives of the author’s research activities at the Life Supporting Technologies group are: the development of a complete middleware based on the middleware architecture of the V2 URC for the implementation of an AmI environment, the development of intelligent agents, for connection and environment management and the development of multimodal adaptative user interfaces using Design for All methodologies in order to make accessible and usable interfaces.

In our research in progress, we are using the implementation of the architecture presented to develop multimodal usable and accessible user interfaces for the creation of an AmI environment. Also, one example of the actual research projects on intelligent agents is a Wireless Connection Agent that complements the proposed architecture.

5. Middleware Architecture

On October 2000, under the American National for Standards Institute (ANSI) and the International Committee for Information Technology Standards (INCITS), the V2 Technical Committee on Information Technology Access Interfaces was created. As part of the work V2 TC does, a set of standards called Universal Remote Console (URC) standards were created [6].

These technical standards present the mechanisms to enable both full functioned remote operation of products and through intermediate devices and intelligent agents. Built on existing network and communication standards, V2 URC adds the necessary components and capabilities so that standardized, flexible and versatile user interfaces can be designed.

The procedures a product can use to provide user interface information for any remote console or artificial agent are also described. This information is enough to construct full-functional user interfaces for the products without any previous knowledge about them. Besides, the procedures allow direct access to the functionality of the products so that an individual can execute a specific command without having to navigate menus to get to them. Therefore, entirely visual, entirely audio, or natural language interfaces can be developed from the information provided by the products.

The V2 URC standards are composed of five documents under the family name "Protocol to Facilitate Operation of Information and Electronic Products through Remote and Alternative Interfaces and Intelligent Agents". They specify the communication mechanisms between a Target—a device or service the user wishes to access — and a Universal Remote Console — software that is typically hosted on a user’s personal device. The connection between the URC and the Targets is called Target URC Network (TUN) and can be established using an intermediate gateway. Figure 1 shows the complete architecture the five URC standards are based on.

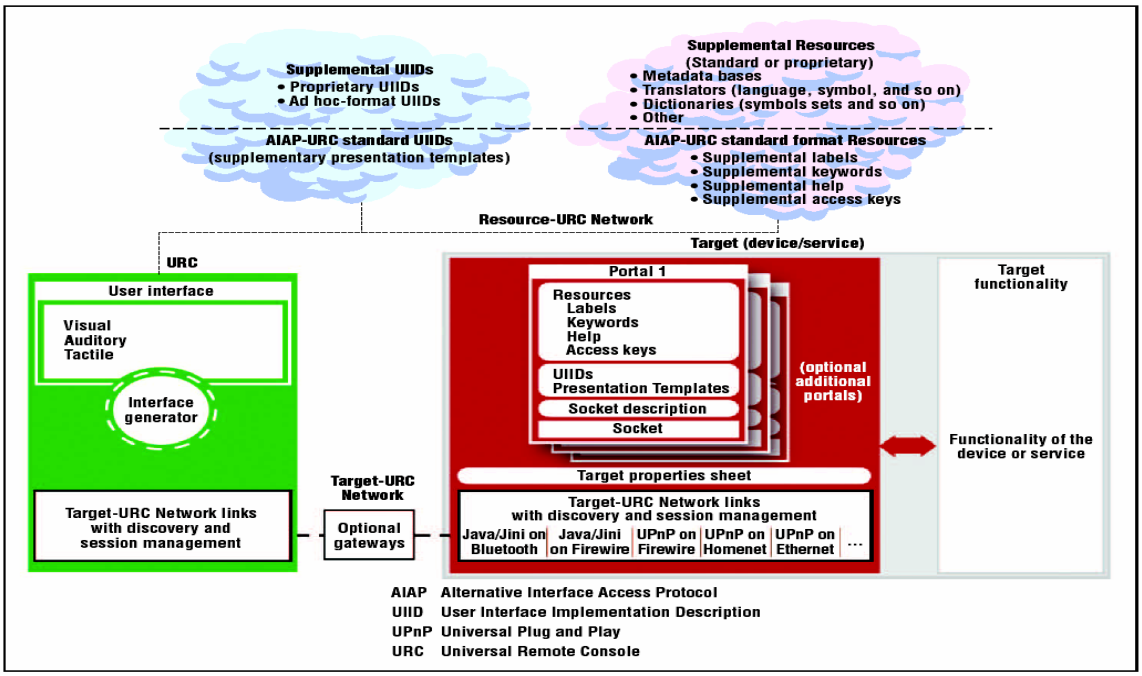

Figure 1. V2 URC Architecture

The first standard of the family is the Universal Remote Console specification which provides a framework of components that enable remote user interfaces and remote control of network-accessible Targets through a URC.

The second document of the family, the Target Properties Sheet specification (TPS), defines a XML document that describes a URC-conformant Target so that it can be discovered by any URC. It provides the information a URC needs to connect to one of the Target Portals and to start a control session.

Third, the User Interface Socket Description specification is a XML-based document which describes a Target functionalities and state in a machine interpretable manner. The socket exposes relevant information about the Target so that the user can know its state and operate it.

The Presentation Template specification is the fourth standard of the family. Different hints to build usable and consistent user interfaces for a Target are defined in XML language. These hints are abstract elements intended to be applied to any delivery context.

Finally, the last document of these standards is the Resource Descriptions specification which defines the syntax to describe relevant Resources for the user interface. Resources are identifiable objects that are used as atomic entities in the construction of a concrete user interface. They can include both text elements of the user interface such as labels, help text, access keys, and keywords, and non-text elements such as icons, sounds, or videos.

6. Wireless Connection Agent

The work accomplished has consisted in the development of a Wireless Connection Agent (WCA) that can establish a TUN between an URC and a Target automatically. The aim of this development was to offer users a transparent way to be connected to the services provided by the V2 products, considering additional relevant aspects such as the connection availability, the bandwidth, the costs and, the most important one, the user preferences.

In computer science, a software agent is defined as an abstraction, a logical model that describes software that acts for a user or other program in a relationship of agency [7]. Such "action on behalf of" implies the

authority to decide when (and if) an action is appropriate.

Taking into account this definition, we can consider the WCA as an intelligent agent capable of both detecting available wireless networks (Bluetooth, Wi-Fi, GPRS, and UMTS) and connecting to the "best" of them.

A Bluetooth connection agent was established using the Personal Area Network (PAN) profile [8], so that the possibilities of a WCA could be tested. Without any cost, and using the BlueZ Linux Bluetooth stack, an automatic connection between a HP 5500 pda, acting as URC, and a domotic gateway, was achieved.

The steps to establish the pda (urc)-gateway connection are:

1. The Bluetooth device that allocates the URC within the radio range and which provides the Personal Area Network User (PANU) service is discovered by means of baseband inquiries and Service Discovery Protocol (SDP) searches.

2. If there are no available Bluetooth connections, the Gateway requests a Bluetooth connection to the selected device with the PANU service.

3. Once connected, the Gateway can create a Logical Link Control and Adaptation Protocol (L2CAP) channel for the Bluetooth Network Encapsulation Protocol (BNEP). The Gateway uses the BNEP control commands and initializes the BNEP connection. Then, the URC may filter different network packet types. If the Gateway supports filtering, it shall store all accepted network packet type filters for each connection.

4. Ethernet traffic can now flow across the link. The URC shall perform various tasks to obtain an IP address and other network services, for example Autonet. Then, the Gateway forwards all Ethernet packets to each of the connected URC. .In our test, the Gateway had a Dynamic Host Configuration Protocol (DHCP) server that provided the IP address.

7. Conclusions

The evolution of information technologies towards an ambient intelligence environment is a complex process where every group of people will have to take part.

The election of appropriate middleware architectures that holds universal access interfaces allows that especially vulnerable groups can access to technology that can improve their quality of life.

The URC architecture meets all the requirements to facilitate the control of accessible and usable AmI environments. It allows the development of adaptive user interfaces depending on the user capabilities and preferences.

The URC intelligent connection management will allow an easier use of the personal URC in any AmI environment compatible with the standardized URC architecture.

Finally, the WCA is a good approach to an autonomous intelligent connection management system. The initial tests with Bluetooth connections have demonstrated some necessary steps to be taken.

8. References

[1] European Commission, *Feasibility Study – Comparable Statistics in the Area of Care of Dependent Adults in the European Union*, Luxembourg: Office for Official Publications of the European Communities, 2003

[2] Batavia AI, DeJong G, McKnew LB, "Toward a national personal assistance program: the independent living model of long-term care for persons with disabilities", *Journal on Health, Politics, Policy and Law*, Fall 1991.

[3] Ambience Project, http://www.hitech-projects.com/euprojects/ambience/

[4] P. L. Emiliani, C. Stephanidis, "Universal access to ambient intelligence environments: Opportunities and challenges for people with disabilities", *IBM Systems Journal*, Vol. 44, Nº 3, 2005.

[5] Alonso, J. Vidal Garcia, *El Movimiento de Vida Independiente, Experiencias Internacionales (The Independent Living Movement: International Experiences), Fundación Luis Vives (Luis Vives Foundation).* Internet publication URL: www.independentliving.org/docs6/alonso2003.pdf, 2003.

[6] Bill LaPlant, Shari Trewin, Gottfried Zimmermann, and Gregg Vanderheiden, "The Universal Remote Console: A Universal Access Bus for Pervasive Computing", *IEEE Pervasive Computing*, January 2004, pp. 76-80.

[7] Wooldridge, Michael, *Introduction To Multi-Agent Systems*, John Wiley & Sons 2002

[8] Bluetooth SIG Inc., *Personal Area Networking Profile V.1.0*, Internet publication URL: https://www.bluetooth.org/spec/, 14 February 2003