URC Based Accessible TV

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ABSTRACT
This paper presents a new architecture to make TV sets accessible for all. Our proposal is based on the ISO/IEC 24752 "Universal Remote Console Framework" standard. This standard defines an abstract user interface layer called the "user interface socket" and allows the development of pluggable user interfaces for any type of user. Since this architecture is standards based, the development of compatible pluggable interfaces is open to any third party. Besides, a prototype of the proposed architecture has been built. In this prototype, the Universal Control Hub (UCH) has been used as the URC framework implementation, a PC with Windows Vista Media Center has been used as a TV Set-top box, and two pluggable UIs have been developed. These UIs consist of an accessible DHTML page for the visually impaired, and a multimodal client, which allows interaction via touch screen and speech. Finally, these two pluggable UIs have been validated with user groups with special needs and preliminary results show encouraging results.

Categories and Subject Descriptors: H.5.2 [**Information Interfaces and Presentation**]: User Interfaces - Standardisation, Input devices and strategies, Interaction styles, Theory and methods, User-centered design; D.2.2 [**D.2 Software Engineering**]: Design Tools and Techniques - User interfaces; H.1.2 [**Models and Principles**]: User/Machine Systems - Human factors; J.7 [**Computers in other Systems**] - Command and control, Consumer products.

General Terms: Design, Experimentation, Human Factors, Standardization.

Keywords: Accessible TV, ISO/IEC 24752, Universal Remote Console -URC, Universal Control Hub - UCH, multimodal interaction, pluggable user interfaces.

EuroITV'09, June 3–5, 2009, Leuven, Belgium.

1. INTRODUCTION
In recent years, relevant research has been carried out in several fields related to television. Significant effort has been focused on developing TV receivers that provide multiple levels of interactivity whilst accessing diverse content and services over the network.

From an accessibility point of view, substantial effort has been made regarding broadcast content and how to convey this content through TV sets. Good examples of such efforts are subtitling for the hearing impaired and audio descriptions of programming for the visually impaired. [1-3].

Despite these advances, one of the key features of the TV, the control interface, has not evolved at the same pace. By control interface we mean the TV remote control and the on-screen display (OSD).

TV remote controls have changed their appearance, advancements in usability have been achieved, but the interaction paradigm based on infrared remote control technology has remained unchanged for more than a decade. Effort has been made to make remote controls as user-friendly as possible [4, 5], but a significant impact on accessibility has yet to be achieved. For many users, remote controls are too complex to use. Some may not see buttons very well, others may not have the dexterity to handle the device or manipulate its buttons without difficulty.

Other users as for example the people with cognitive difficulties require training on how to use the remote control. Even so, many times they are unable to remember the location of the buttons on the remote control or how to use the TV's OSD menus.

Due to these barriers, advancements in Interactive TV, and the services offered via the TV set, are not reaching their full potential with all user groups, missing out on a great opportunity to bridge the digital divide for people with special needs [6].

In this paper, we first briefly explain the URC framework that we used. Section 3 details our contributions, i.e., an approach that enables real accessible TV. In section 4, we describe our implementation. In Section 5 we summarise the paper and present our conclusions.

2. The URC framework

The Universal Remote Console (URC) framework [7] was published in 2008 as a 5-part international standard (ISO/IEC 24752). It defines a "user interface socket" (or "socket" for short) as the interaction point between a pluggable user interface and a target device or service. In the context of the URC, pluggable user interfaces are either generic, i.e., generating a user interface based on the socket description, or specific to a socket, i.e., relying on hard-coded knowledge about the socket.

URC technology is an open user interface platform, allowing third parties to create a pluggable user interface and use it with any device or service that exposes its functionality through a socket. The framework includes "resource servers" as global market places for any kind of user interfaces and resources necessary for interacting with appliances and services to be shared among the user community.

Besides, the Universal Control Hub (UCH) is a gateway oriented architecture for implementing the Universal Remote Console (URC) framework in the digital home [8].

The main features of the UCH are:

- It acts as a bridge between targets and controllers: each with its own communication and control protocol, that otherwise would be unable to talk to one another.
- Standard-based user interface socket: The UCH is based on the URC framework previously described.
- A variety of user interface protocols: The UCH allows different user interface protocols (DHTML over HTTP, Flash, etc.) to be implemented and used by controllers.
- Globally available resource servers: The UCH can get distributed resources, such as target adaptors, target discovery modules and user interfaces from resource servers. An example of such a globally available resource server is dotUI [9].

Figure 1 shows the UCH architecture for the URC standard.

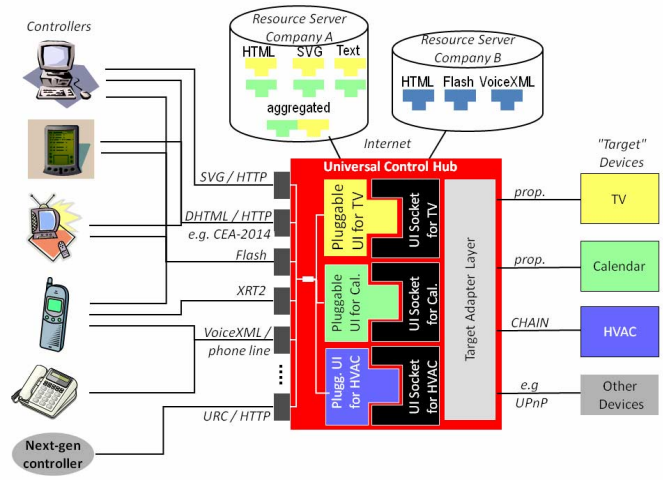

Figure 1. UCH architecture

In the UCH architecture, a User Interface Protocol Module (UIPM) is responsible for presenting one or multiple sockets to the user through a user interface that is rendered on a controller. Controllers and their software, aware of this type of architecture, might want direct access to a target's socket and its atomic resources, in order to build a suitable user interface based on the socket elements and their values.

Finally, the URC-HTTP protocol, as defined by [10], facilitates remote access by a controller to the sockets running in a UCH. This protocol defines the HTTP-based messaging and functions for a controller accessing the sockets on a UCH. The implementation of this protocol is optional for a UCH, but once implemented it offers a standardised and powerful method for clients to access the UCH.

3. PROPOSED ARCHITECTURE FOR ACCESSIBLE TV

In this paper we propose the use of the URC framework to make the TV universally accessible. The main advantage of the URC framework is that it allows the development of pluggable user interfaces. Given this fact, tailored user interfaces for any kind of user can be implemented to remotely control a TV.

Figure 2 outlines our proposal in contrast with the current scenario.

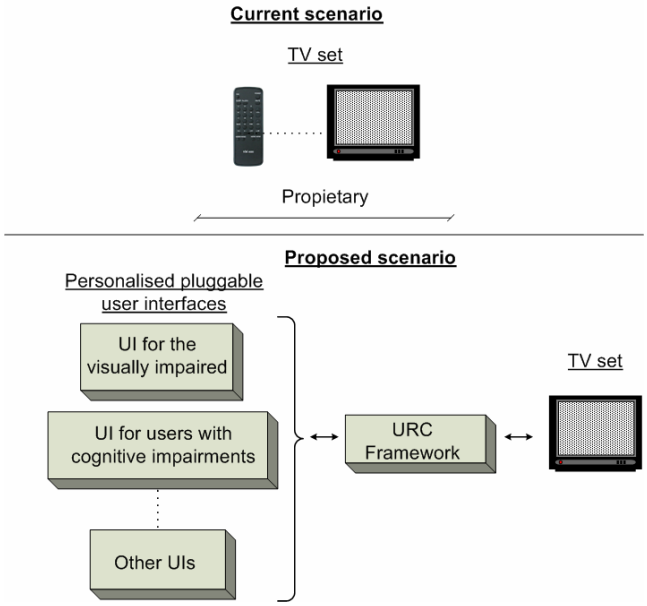

Figure 2. Current scenario vs. proposed architecture for accessible TV

In addition, the URC-based approach is an open and standard-based solution. This implies that the proposed architecture allows third parties to develop personalised pluggable user interfaces that best fit different user groups' preferences or needs for remote control of TV sets. Moreover, these UIs may run on different personal devices such as mobile phones, PDAs, laptops, etc.

Finally, the URC framework can be embedded in the TV set itself or in current TV Set-top boxes.

4. IMPLEMENTATION

Next, we describe the prototype that has been built to demonstrate the concept.

In our implementation, the UCH acts as a gateway allowing pluggable UIs to remotely control the TV set. The device used to offer TV services was a PC with Windows Vista Media Center (MCE). We chose this platform because it provides a well-documented API and supports the development of add-ins for this platform.

Next, we implemented the UCH as an MCE add-in. In this way, the UCH is seamlessly integrated into the MCE application. The UCH integrated in the MCE has been developed in C# for the .NET framework.

Moreover, we developed the following components to customise the UCH for current TV device scenario.

Firstly, we list the XML documents specified by the URC standard:

- Target Description (TD): This document is used to advertise the properties of the TV set to the client. The TD provides the information required by a client to connect to a TV's UI socket in order to initiate a control session. A Target has exactly one TD.
- User Interface Socket Description (SD): A User Interface Socket Description is a XML document with a machine-readable description of the TV's functionality.
- Target Resource Sheet (RS): A resource sheet is a file that defines the resources that can be used in the construction of a user interface. For example, language specific strings, icons and other GUI elements.

Secondly, specific code for the UCH architecture is listed:

- Target Discovery Module (TDM): The function of this module is to discover TVs and any other related devices such as DVD players, Home Theatres, etc. to be controlled from the UCH. At least one discovery module must exist for each communication protocol.
- Target Adapter (TA): A TA is a module that communicates with a specific Target (TV, DVD player, ...) in its native protocol (the Vista Media Center API in our case), with the relevant socket instance via the Target Manager as to update the state of the socket values, or to receive commands from the controllers via the socket manager.

Next, we developed two pluggable user interfaces, which are presented in the following subsections. These pluggable UIs are just two examples of many possible UI paradigms. These pluggable user interfaces are Plug-and-Play, which means, that UIs can be dynamically loaded and used from our controller on-the-fly.

Both pluggable UIs communicate with UCH using the URC-HTTP protocol. As already mentioned, other user interface protocols are available to the UCH and can be employed in the development of other user interfaces.

Figure 3 illustrates the implemented solution.

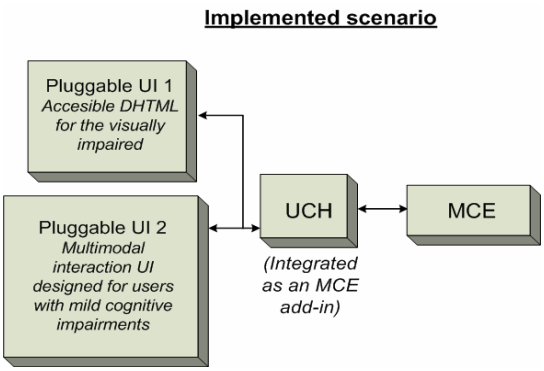

Figure 3. Implemented solution for accessible TV

Below, we describe two UIs that implement solutions for user groups with special needs. End user associations have been consulted for the design of the UIs. The interfaces have been developed following a user-centred design methodology.

4.1 PUI 1 – Accessible DHTML for the visually impaired

This pluggable user interface is based on a DHTML page running on a vertically handled tablet-PC. This tablet-PC connects to the UCH using the URC-HTTP protocol over a wireless connection. The URC-HTTP protocol is implemented as a JavaScript library [11] and this library is used in the HTML to interact with the TV via the UCH.

The DHTML page is rendered in a web browser. Both Microsoft Internet Explorer and Mozilla Firefox are supported. This DHTML has been correctly tagged so that it is compatible with screen readers such as Jaws [12].

Figure 4 illustrates the accessible DHTML page. This DHTML page has been developed in accordance with the WCAG 2.0 guidelines [13]. The Web Page is designed using big buttons and fonts. The colours can be changed in case the user has problems with the displayed colours. Colours and font sizes can be adapted easily to the users' needs by the use of style sheets. This DHTML page even allows for different colour schemes depending on the time of the day, which would be very helpful for some of the visually impaired.

Target users of this pluggable UI are both people with visual impairments and the blind. At time of writing, this article's validations with target users are being carried out. Preliminary results show a good acceptance of the proposed architecture.

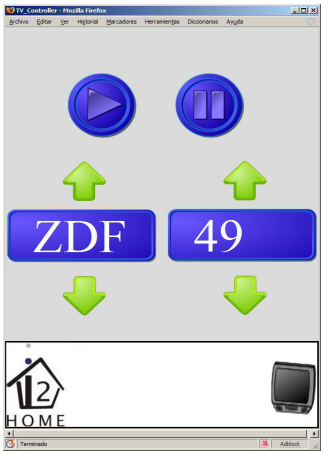

Figure 4. Web Browser with accessible DHTML

4.2 PUI 2 – Multimodal UI on Smartphone

The second pluggable user interface has been developed using the Ontology-based Dialogue Platform, ODP [14]. This user interface consists of a multimodal interface running on a HTC 7500 Advantage PDA using a client-server architecture. The main criteria for the selection of this device, see Figure 5, were its relatively large touch screen in combination with a modern design, the latter in order to avoid stigmatisation.

The UI provides the possibility of combined speech and finger gesture input.

Communication with the UCH is identical to the first pluggable user interface, using URC-HTTP over a wireless connection.

This pluggable UI was designed specifically for people with mild cognitive impairments. It was designed to have the minimum number of navigation steps as possible to access a specific function, and large icons to assist the user.

Figure 5 represents the HTC 7500 Advantage rendering the pluggable UI developed for people with mild cognitive impairments.

Figure 5. HTC 7500 Advantage controller displaying the Pluggable UI developed for people with cognitive impairments

The graphics and gesture part of this UI was evaluated with 10 persons, yielding good results. The chief criticism was related to an animation for the selection of TV channels, see [15].

5. CONCLUSIONS

In this paper we propose a new concept that makes TV sets accessible for all. The architecture is based on the ISO/IEC 24752 Universal Remote Console (URC) standard.

This architecture allows the deployment of Plug-and-Play user interfaces. In this sense, customisable pluggable UIs can be developed by third parties to address the needs of different user groups. This situation has opened the door to a new market of UIs. Business models for this new market are still a topic of research, but resource server based marketplaces may be the best approach.

Additionally, we developed an implementation of the proposed concept. In this prototype we used the UCH architecture as an implementation of the URC and the Vista Media Center as an example of a TV set. In the same way, it is also possible to embed the UCH into an existing TV set or TV Set-Top box.

Furthermore, we implemented two pluggable UIs to demonstrate accessibility for people with visual impairments and people with mild cognitive impairments. Validation with these target users is being carried out and preliminary results show good acceptance.

Finally, we believe that this architecture will help to unleash the full potential of the TV by means of allowing advanced UIs, natural language UIs, and UIs that seamlessly span over multiple devices such as DVD players, Home Theatres and Home Automation.

6. ACKNOWLEDGMENTS

This work was partially funded by the EU 6th Framework Program under grant FP6-033502 (i2home) [16]. The opinions herein are those of the authors and not necessarily those of the funding agencies.

7. REFERENCES

[1] Klein, D.J.A., Karger, S.A., and Sinclair, K.A. 2003. Digital Television For All: A report on usability and accessible design. Technical Report. The Generics Group.

[2] AENOR. 2003. Subtitling for deaf and hard-of-hearing people. Subtitling by teletext. UNE 153010.

[3] AENOR. 2005. Audio description for visually impaired people. Guidelines for audio description procedures and for the preparation of audio guides. UNE 153020.

[4] Falck Vital. Last access date: 28th January 2009. Falck 5117. http://www.falckigel.com/shop/index.aspx?intshopcmd=&group=1450&prod=2669.

[5] Weemote. Last access date: 28th January 2009. weemote® Sr. TV Remote for Adults. http://www.weemote.com/weesrlm.html.

[6] European Commission. 2007. Assessment of the Status of eAccessibility in Europe. http://ec.europa.eu/information_society/activities/einclusion/library/studies/meac_study/index_en.htm

[7] ISO/IEC. 2008. Information Technology - User Interfaces - Universal Remote Console (5 parts). ISO/IEC 24752.

[8] Zimmermann, G., and Vanderheiden, G. 2007. The Universal Control Hub: An Open Platform for Remote User Interfaces in the Digital Home. In Proceedings of Human-Computer Interaction International 2007 (Beijing, P.R. China, July 22-27, 2007). HCI'07. Springer, Heidelberg, LNCS 4551, 1040—1049.

[9] dot UI. Last access date: 28th January 2009. http://www.dotui.com/.

[10] URC Consortium. Last access date: 28th January 2009. URC-HTTP Protocol 2.0. http://myurc.org/TR/urc-http-protocol/.

[11] URC Consortium. Last access date: 28th January 2009. Webclient JavaScript Library. http://myurc.org/tools/Webclient/index.php

[12] Freedom Scientific. Last access date: 28th January 2009. Jaws for Windows. http://www.freedomscientific.com/fs_products/software_jaws.asp

[13] W3C. Last access date: 24th March 2009. Web Content Accessibility Guidelines (WCAG) 2.0. http://www.w3.org/TR/WCAG20/.

[14] Neßelrath, R., Schulz, C., Schehl, J., Pfalzgraf, A., Pfleger, N., Stein, V., and Alexandersson, J. 2009. Homogeneous Multimodal Access to the Digital Home for People with Cognitive Disabilities. In Proceedings of the second German Congress on Ambient Assisted Living (Berlin, Germany, January 27-28, 2009)

[15] Schehl, J., Pfalzgraf, A., Pfleger, N., and Steigner, J. 2008. The babbleTunes system: talk to your ipod!, In Proceedings of the 10th international conference on Multimodal interfaces (Chania, Crete, Greece, October 20-22, 2008). IMCI '08. ACM Press, New York, NY, 77--80.

[16] I2home. Last access date: 28th January 2009. Intuitive Interaction for Everyone with Home Appliances based on Industry Standards (i2home). http://www.i2home.org.