AN OPEN, EXTENDABLE SERVICE PLATFORM FOR THE ELDERLY

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Abstract: Addressing the needs of the elderly is a challenging but imperative task in most Western societies. There is general consensus that the best way to improve this situation is the progressive introduction of technical aids to allow users achieving a more independent life. However, senior citizens frequently have difficulties to make use of the advances in our modern information society technology because it requires that they need to learn from scratch how to use some sort of specific terminal. Elderly users demand specially designed interfaces that are: simple, affordable, always ready, integrate easily in their living environment and offer a single access point for all services. In order to cope with these difficulties, the VITAL project proposes a combination of advanced information and communication technologies that uses a familiar device like the TV as the main vehicle for the delivery of internet services to elderly users in home environments. In this paper, we describe the platform architecture, as well as the web-based applications and their integration into the platform.

1 INTRODUCTION

Today's internet is mostly an ever-growing collection of rather static information making the interaction rather predictable and thus simple. It has a potential to allow a larger or lesser part of the society to interact with it depending on the quality and complexity of the man-machine interaction technology. As we move along the timeline, the internet becomes dynamic and therefore more unpredictable and demanding to use, especially for the elderly. As we are approaching Web 3.0 and the Internet of Services, there is a risk that the gap between technology and its usability increases even more: the Digital Divide becomes a manifestation.

Given the considerable increase in the number of elderly persons, elderly users will demand more and better services and more important they will have the necessary resources to force the attention of public and private organisations to their needs thanks to their increasing political (through their vote in elections) and economical power. It is evident such a complex problem cannot have a single 'magic' solution. It will be the combination of several individual efforts what will make possible to address one of the most challenging topics of modern society. Some aspects that could help improve the situation: anticipation (a significant amount of assistance resources are wasted because users are not prepared in advance to face their retired life), independent living (providing the users with the means to solve their own problems is the key for a significant optimisation of resources), integration into the mainstream society (special services are always expensive and inefficient, integrating assistance schemes into the general activity of the society instead of treating it as an isolated world will significantly improve the situation), massive introduction of advanced technologies (with the aim to optimize resources and address new needs).

The European FP6 project VITAL attempts to address the needs of the elderly. The objective of the VITAL project is to develop a new services platform with the aim to significantly increase the quality of life of the average elderly user. The new platform departs from traditional assistance schemes in the sense that it is not only oriented to satisfying day to day subsistence needs but it considers also other important demands that have deserved little attention up to the

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moment, such as the need for: information, communication, entertainment, self-education, etc. It aims at developing natural and adaptive multimodal interfaces for the domestic TV and mobile environments that respond intelligently to speech and language, vision, gestures and other senses, interfaces able to capture user desires and deliver enriched audio-visual content while causing minimal interference with the user's activity.

The project encourages and serves users that are willing to achieve an active life inside or outside their home environment. A necessary condition to make those objectives possible and to introduce our seniors into the world of the information technology is to provide solutions to the interfacing barrier and here it is where VITAL comes into play. VITAL offers a personalised companion for the elderly materialised in a distributed system, supported on static (TV) and mobile front-ends, where each user will have an associated personalised agent able to interact with the user and with agents from other users. Under the umbrella of this personal assistant the users have access to a complete catalogue of personalized services.

The remainder of the paper is structured as follows: in Section 2 we give an overview of the VITAL platform architecture, providing multimodal interaction for the VITAL services which are described based on an example in Section 3. Section 4 discusses related work and Section 5 concludes.

2 THE VITAL PLATFORM

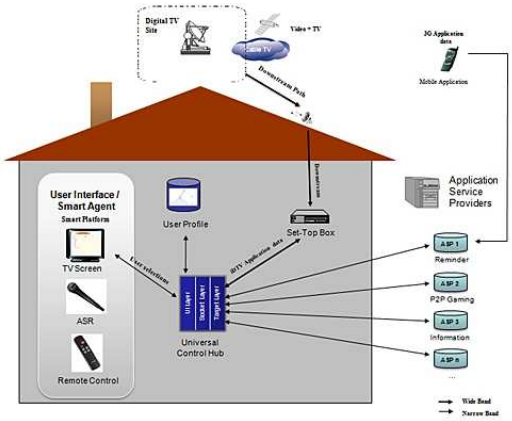

Figure 1: VITAL platform overview.

The VITAL platform is devised as an open, extendable platform, for web-based services and applications on the TV and mobile phone, designed especially for the elderly, where services and applications may be added or removed with minimum impact over the rest of the system. Furthermore, the system may dynamically alter system configuration using different criteria. The modular design will also help to minimize the risks associated to some of the unproven or emerging technologies necessary for the most advanced features of the project.

The basic layout of the VITAL Services Platform is depicted in Figure 1. Elderly users get access to the system services using Fixed or Mobile Terminals, connected to the VITAL Platform and Services by means of the communications infrastructure available at the user's site. Internal and external Service Providers provide applications which increase the quality of life for the elderly.

The VITAL platform is based on several pillars which are described in more detail in this paper:

- Universal Control Hub (UCH) as a middleware which separates the target devices and services functionality from their user interfaces.
- A speech and natural dialogue processing engine which is capable to use natural language as an additional means for communication with the user.
- A TV-oriented implementation of the user interface layer (User Interface Protocol Module, UIPM) for the UCH.
- A set of internet based applications for the elderly.
- Mobile application infrastructure for out-of-home usage.

2.1 Multi-modal GUI

Designing an advanced environment for the elderly is a big challenge since elderly users require specially designed interfaces that are: simple to use, affordable, always ready, integrate easily in their living environment and offer a single access point for all services. Most previous attempts to introduce aided services in the elderly community have failed; a computer (in its traditional fashion) is an element foreign to most users' environment that requires skill, modifies their way of living and has been systematically refused by the users. In that sense, one of the most important decisions is the selection of an adequate user interfacing approach that is respectful with the above requirements. Using a TV in conjunction with a remote controller is currently the best solution to solve the interfacing needs, as it is a familiar and recognised interface and facilitates access to a wide range of information and communication services for these types of users.

For the TV based VITAL platform, a simplified remote control is used[1]. It allows navigating the appli-

[1]http://www.weemote.com

cation with a small set of buttons which are assigned in a uniform way across the different applications.

Furthermore, in order to ease the navigation even more, multimodal interaction is supported. The Multimodal Dialogue System (Schehl et al., 2008) allows more intuitive control of the system by means of speech and gestures and permits a natural dialogue between man and machine. The user is able to issue combined voice commands and gestures to modify the performance of the 3D environment and to search for information related to the objects or applications in scene. The VITAL system consists of a number of independent applications, each of which is controlled by its unique set of gestures, voice commands and its dialogue system.

2.2 URC Standards-based Middleware

The overall system architecture is based on two standards: the ISO standard 24752 'Universal Remote Console' (URC, see http://myurc.org and http://www.i2home.org) and the CEA 2018 'Task Model Description'. The URC framework has been developed to address the need for pluggable and personal user interfaces. The concept calls for a decoupling of the functionality of a device or service, and its user interface (hence 'pluggable user interface'). This relieves the developer from having to provide one user interface in a one-size-fits-all approach which is not suitable, in particular for older users. The URC technology allows for personal user interfaces that are tailored to a user's controller, context of uses, and their individual needs and preferences. Pluggable user interfaces can use any user interface technology, using any modality for input and output (e.g. HTML, Web 2.0, Java, C#, VoiceXML, proprietary technologies, etc.). The technology allows for hard-coded ('canned') user interfaces (designed and specified before runtime), and user interfaces that are automatically generated and/or adapted at runtime.

Main part of the URC standard is a middleware, the Universal Control Hub (see Figure 2), or UCH that serves as 'user interface middleware' between on the one hand appliances and services (called 'Targets') and on the other hand personal user interfaces implemented on some platform (called controllers). The rendition of a Target's user interface is guided by 'Resources' that the Universal Control Hub (UCH) retrieves from Resource Servers on the Internet. The URC standard implements an architecture called pluggable user interfaces meaning that a user interface can – even dynamically – plug into the UCH which can serve multiple user interfaces. Important is also that the interaction in this architecture is bi-directional, that is, the user is possibly informed as the targets change their state. The UCH acts as the central component, connecting TV, remote control and microphone with the platform components (user profile etc.) and to services available in the Web.

2.3 UiTV

The UiTV is the main user-interface integration framework for TV used in the VITAL project, developed by CTU[2]. UiTV is capable of rendering user interfaces described in CTU-UIProtocol. Applications based on CTU-UIProtocol are nested to the UiTV user interface. The UIProtocol provides a server-side API for writing event handlers in both .NET and JScript (Microsoft variant of JavaScript). The API provides simple access to sockets and enables easy updates for user interfaces of connected clients.

3 VITAL APPLICATIONS

The VITAL Services are designed to address real needs of the elderly population with the aim to improve their quality of life, increase their cultural level, fill in their leisure time, integrate the elderly population into mainstream society and incorporate this sector of the population into the information technology world. The applications highlight the social aspect of the project objectives, especially those services which involve two or even more users into an interaction.

The VITAL catalogue of services (see Figure 3) includes the following facilities: communications, social interaction, entertainment, education and information, involving full integration of services for elderly users and service providers, use of appropriate terminals for each user profile (i.e. the TV or mobile), use of natural language to communicate with the machine, strong emphasis on personalisation, carefully designed interfaces and the use of existing infrastructures.

Based on the URC approach, it is possible to add or remove applications / services from the system without altering the basic system functionality. The applications may run on themselves or may use the support of the lower level services provided by the VITAL Platform (i.e. information from the user profile, location services, reminder service, etc). In addition, the applications, through well-defined interfaces can provide user information to the platform in order to update the user profile.

[2]Czech Technical University, www.cvut.cz/

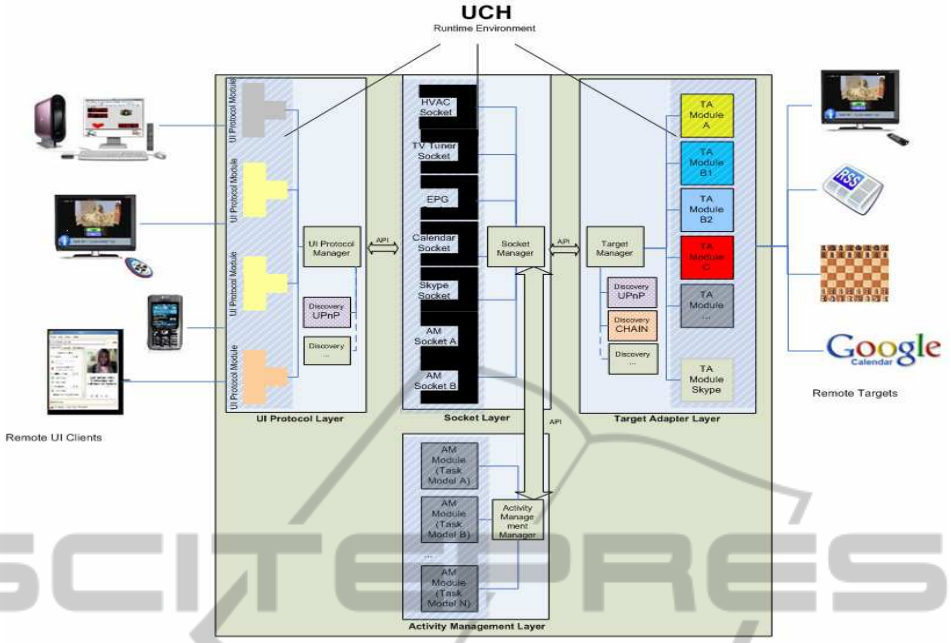

Figure 2: URC architecture overview.

In the project, a set of services were developed to show the diversity of internet applications which can be supported and integrated.

- Video-conferencing.
- Peer-to-peer gaming.
- Audio books.
- Edutainment.
- Tourist Guide.
- Broadcast news search and transcription.
- Information service.
- Personal Newspaper.

Using the example of the Personal Newspaper, we will describe in detail its features and the technical integration into the platform.

3.1 Personal Newspaper

Elderly people are often reluctant to use new media because of technophobia. Since the VITAL system is intended to be used by this population segment, we decided to avoid the use of Web browsers, direct access to search engines (instead, the information service invokes a query on behalf of the user), and even hide the fact that the user accesses the Internet at all. The complexity of Web pages with different frames, links and advertisement is hidden and only the content related information is visible for the user. In order to accomplish transparency of the content for the elderly, we encapsulated the knowledge about the Web site we use into the project's ontology. Instead of showing a Web page, the concepts of the ontology are displayed. Using this approach 'Web-surfing' is substituted by browsing through an ontology tree (Zinnikus et al., 2004), thus improving web usability for digitally disadvantaged persons.

To implement the service, a sophisticated HTML Extraction Toolkit to analyse Web pages and to extract information out of HTML Web pages has been developed. For most of the topics users are interested in, we concentrate on a limited number of Web pages that contain appropriate information, e.g. news about sport events. Since the structure and code of most Web pages changes over time, the toolkit must not only be able to extract content from a static page structure, but must also be flexible enough to handle structural changes in the HTML code. The HTML extraction toolkit allows adaptation to the changing structure of Web pages using information extraction rules. Rules are specified offline and executed at runtime.

Technically, the extraction is accomplished with the help of an HTML parser by applying tree matching rules on the resulting DOM tree (Kilpelainen, 1992). Like an XML parser, the HTML parser generates a DOM tree representing the content of a document. Extraction rules specify the path within a DOM tree where the desired part of information is to be found. This information may not only consist of text normally displayed by a browser, but also contain

Figure 3: VITAL platform main menu.

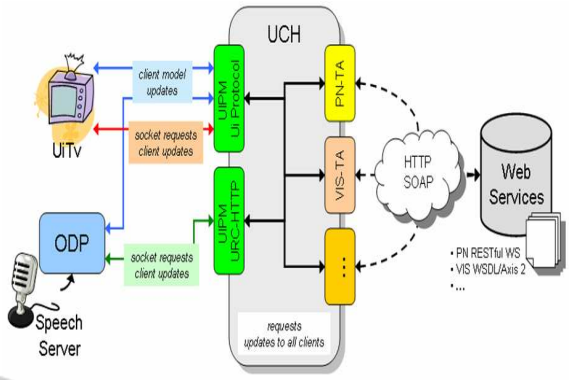

Figure 4: Information and Personal newspaper service integration.

links to other Web pages which contain further information. These links are often generated dynamically e.g. by Web portals or database front-ends. Since the toolkit can also handle such generated links, our approach is not limited to statically defined Web pages.

After applying the rules, the extracted information is evaluated by the service, which calculates an interest level based on the user profile. This procedure is repeated several times for a list of Web pages which are considered important for the user's request. The overall result is a list of topics ordered according to the user's presumed interest.

Another important advantage of this general approach for content extraction based on the extraction toolkit is that (provided that encoding problems can be solved) the tool allows customizing the news service to any other language. This was particularly helpful in the context of VITAL, where an English and a Spanish version had to be maintained in parallel.

3.1.1 Platform Integration

The personal newspaper backend service is a RESTful web service which is encapsulated as UCH target for the VITAL platform (see Figure 4). This procedure opens up a huge number of new application areas and services in the WWW which could be added to the VITAL platform. The VITAL platform is conceived as an open, extendable platform which is not limited to the applications described in this paper. It should be possible – at least in principle – to add any other available service to the platform without changing or modifying the service itself.

In order to do that, in a first step the functionality of the service has to be analyzed. A service in the WWW is generally accessed by calling a URL. Inside a web page, there are additional URLs displayed which give access to further resources (i.e. via hyperlinks). In the case of the Personal Newspaper standalone service, several cases are present:

- Links for categories/rubrics (e.g. Sport, World News, etc.).
- Links for scrolling to the previous or next category/entry.
- Links for scrolling an article which is longer than the page size.

Adding the service to the UCH-based VITAL platform first requires to specify the socket description and implement a target adapter for the service accordingly. The socket description must be specified in a way such that all possible (or at least relevant) hyperlinks in the service can be addressed. E.g. there must be a command which allows getting the different categories provided by the newspaper service. Furthermore, commands must be specified to scroll to previous/next entries and within an article.

Hyperlinks in RESTful services refer to resources (Richardson and Ruby, 2007). Resources are in this case the entries (articles) in the newspaper, including headline and body of the article. When accessing these hyperlinks, the service responds by sending the resources to the requesting client.

A command in the UCH socket allows retrieving an article identified by an URL. The socket hides the actual URL address. Instead it introduces an array for each category which contains the articles available for each category. This encapsulation or view approach is not strictly necessary, but defines access to the resources in a more intuitive way. Dependencies between commands are used to ensure that a command is invoked e.g. only if the user is already logged in.

Access to the service and thus to the resources is provided by the implementation of the target adapter. If a command on the socket is invoked, the target adapter sends an HTTP request to the server on which hosts the Personal Newspaper service. The target

adapter e.g. gets a request from the UI part for the first entry in the category *Sport*.

The target adapter then accesses the service by sending an HTTP request to the service, containing a URL. The URL identifies a resource (an article) on the server. The service responds by sending the resource (a headline and a text) which is then converted according to the format specified by the socket description and sent back to the UIPM component.

For the integration, the implementation of the Personal Newspaper backend service was not modified except concerning the format of the response: the stand-alone service accessed by a Web browser responds with HTML format, whereas the integrated service sends back well-formed XML. This allows parsing the response with standard XML parsers and extracting the returned data with corresponding standard languages (e.g. by using XPath expressions[3]). If a completely external service has to be integrated to the platform, this step has to be extended by analyzing the possible HTML responses and extracting the relevant data with specialized tools.

Using this procedure, an arbitrary service can be integrated and made available to the users of the VITAL platform.

4 RELATED WORK

There are a number of middleware technologies available today. Inside the home, there are various networking platforms for the interoperation of networked devices and appliances. In consumer electronics, there is an increasing trend for high-end devices to be furnished with the ability for remote control via a home network (Biggs, 2009). With standardised networking protocols, the use of general-purpose controllers and intelligent user agents is possible. One of the networking platforms used in this area is UPnP (Universal Plug and Play).

Outside the home, service-oriented architectures (SOA) as an architectural style for distributed systems, have been gaining momentum over the last few years and are now considered as mainstream in enterprise computing. Compared to earlier middleware products, SOAs put a stronger emphasis on loose coupling between the participating entities in a distributed system. Web Services (Alonso et al., 2004) are the technology that is most often used for implementing SOAs. Web services are supported by a stack of Internet standards (HTTP, XML, SOAP, WSDL, and UDDI). Today, the frontend of service-oriented architectures to the private user is via Web browser technologies. These DHTML user interfaces do usually not cater for a user's individual needs and preferences regarding user interaction and service provision.

[3]http://www.w3.org/TR/xpath/

5 CONCLUSIONS

In this paper, we presented the VITAL project which aims at improving the quality of life for the elderly. We described the basic assumptions, the architecture of the platform and the approach for an adaptive user interface which allows for multimodal interactions. The VITAL applications are specifically designed to serve the purpose of increasing the level of social interactions among the elderly participants.

Evaluations and tests were conducted at users' sites in three circles so that applications could be adjusted to the testing experience. Two types of testing are performed: testing with private home users and testing in public sites such as: residences or day centres. The feedback proved that users have a considerable interest especially in applications which allow interaction and communication with others.

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