MULTIMODAL INTERACTION TECHNIQUES FOR AMBIENT ASSISTED LIVING (AAL)

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ABSTRACT

This work describes several infrastructure contributions targeted to enhance the interaction with Ambient Assisted Living-AAL [1] environments, so that elderly people can maximize the time they live independently, through the help of Information and Communication Technologies-ICT at their homes.

Traditional interaction mechanisms, such as the keyboard, mouse or the usage of tactile screens to interact with the environment are only suitable for elderly people with ICT familiarity, but they are not friendly enough for most of the elderly that have never interacted with this kind of interfaces. That is the reason why this work proposes a set of multimodal interaction alternatives with the environment combining more natural communication channels like voice, images, videos and non-intrusive sensors and devices which interact by themselves, in an implicit manner, with the environment.

1. INTRODUCTION

Ambient Assisted Living is an initiative of the European Union to emphasize the importance of addressing the needs of the ageing European population by reducing innovation barriers on ICT.

Interacting with the technological environment is a key aspect for the success of any project on AAL. New and varied multimodal interaction models are needed in order to have a satisfactory interaction, so they enable a natural and non-intrusive way of communication with the environment. From the human-computer interaction point of view modality refers to the different human sensory channels like vision, hearing, touch, smell and taste [2].

This work describes the effort and techniques we are using to design multimodal interfaces in our AAL related projects.

2. RELATED WORK

There are several European projects whose aim is the development of technology focused on improving the independence, security and health of the elderly people at their homes [3][4][5]. These projects use multimodal interfaces to interact with the environment. Most of them offer a graphical user interface, based in Web technology, as a primary interaction option. Works like the one of Chadwick-Dias [6] et al., study how elderly people interact with these kind of Web interfaces.

The speech-based interaction is the most natural communication channel for the human being. Nowadays Speech Synthesis is a stable technology and Speech Recognition has more and more efficient systems. There are other interaction models, for example:

- Gaze and vision-based interaction that capture and interpret the gestures of the eyes, lips, head, hands, arms, etc. though a webcam.
- Haptic interaction that use special devices that allow the user to touch, feel and handle 3D objects in virtual environments
- Human-Biometric Sensor Interaction with areas like fingerprint recognition, hand geometry, and dynamic signature verification.

Increasing sensory, computational and communicational capabilities of mobile devices make them an excellent option to drive human-environment interaction [7]. The Digital Terrestrial Television (DTT) is also an interesting and alternative platform to personal computers in order to offer services in domestic environments [8]. There are also works [9] that try to recognize human activities from body-worn sensors which can further open the door to a world of healthcare applications, such as fitness monitoring, eldercare support, etc.

3. ZAINGUNE PROJECT

In the already finished research project ZAINGUNE [10], we present middleware and hardware infrastructures to facilitate day-to-day living activities for elderly people at their homes. At the moment, we are working in a new project based in ZAINGUNE oriented to old people's home. This project includes remote-assistance services that demand new interaction mechanisms with the resident's monitoring devices, and new and intuitive communication channels with their caregivers. We are

also involved in a recently initiated project which objective is to use the mobile telephone to interact with the environment. In these two projects we use the following multimodal interaction techniques and mechanisms:

- GUI based interaction. This is the default recommended method of interacting with a ZAINGUNE-enhanced environment. An easy to use interface, namely Environment Controller, based on big gadgets with meaningful icons and big buttons that enable to control the system in a homogeneous manner
- Voice-based interaction. Both a remote and local user can interact with the environment by using preset keystroke configurations to control the environment elements. The same commands can also be issued through voice. This interaction mechanism is possible thanks to the integration of the Asterisk VoIP system with ZAINGUNE infrastructure. Besides, as a side effect of the wide deployment of VoIP phones over the house, we use their speakers to offer vocal feedback to users when alert situations take place.
- Body-worn sensors. Every inhabitant of a ZAINGUNE instrumented environment may carry an alert bracelet. This rather restricted custom-built device has been designed for only one purpose, i.e. assistance seeking or alert notification. We want to improve by adding living signal monitoring sensors like pulsometers, cardiac and blood pressure monitors, fall detectors, etc. The main advantage of these devices is that they work in an autonomous way, without the need of human intervention. The great challenge is to make them non-intrusive enough so they do not interfere in the people's way of living.
- Mobile device interaction. We are using mobile devices to facilitate novel and multimodal interaction methods, including video and audio communications, real world sensorization, and implicit, context-based control. In addition, the mobile can interact with the signal monitoring sensors.

Multimodal systems need a large and unpredictable number of interaction elements and devices. This requires a modality abstraction based on a multi-layered architecture that makes the interaction layer independent. In our platform the interaction layer leans on a middleware that has the following layers: hardware device layer, software platform layer and application environment layer.

4. FUTURE WORK

From now on, the main challenge we think about is to get more natural and easy-to-use interaction mechanisms for the elderly people. In order to get this objective we have proposed the following steps:

- Use new interaction models, specially using mobile devices.
- Identify existing elderly people user profile, according to their personal and functional characteristics that affect the interaction with Ambient Assisted Living (AAL) environments.
- Study and detect the problems and facilities that users identified in the step before have when they interact with the environments. For this purpose we will carry on user tests using different interaction mechanisms.
- Develop interface design guidelines for the design of multimodal user interfaces, which indicate the most appropriate interaction mechanisms for each kind of user.

5. REFERENCES

[1] The Ambient Assisted Living Joint Programme. http://www.aal-europe.eu, (2008).

[2] M.M. Blattner and E.P. Glinter, "Multimodal Integration", IEEE Multimedia, Winter, 14-24 (1996).

[3] PERSONA Project Web Page, http://www.aal-persona.org/, (2008).

[4] ALADIN Project Web Page, http://www.ambient-lighting.eu/, (2008).

[5] SOPRANO Project Web Page, http://www.soprano-ip.org/, (2008).

[6] Chadwick-Dias, A., McNutty M., Tullis, T. "Web Us-ability and Age: How Design Changes Can Improve Perfor-mance". In ACM Conference on Universal Usability, Vancouver, British Columbia, Canada, ACMPress, pp. 30-37. (2003).

[7] Korpipaa, P. , Malm , E.J, Rantakokko, T, Kyllonen, V., Kela, J., Mantyjarvi, J., Hakkila, J., Kansala, I. "Customizing User Interaction in Smart Phones". IEEE Pervasive Computing 5(3): 82-90 (2006).

[8] Ceccaroni, L., Febrer, A., Hernández, J.Z., Martínez, E., Martínez, P., Verdaguer, X. Using AI to make interactive televisión more usable by people with disabilities. DRT4ALL (2005).

[9] Choudhury, T., Borriello, G., Consolvo,S., Haehnel, D., Harrison, B., Hemingway, B., Hightower, J., Klasnja, P., Koscher, K., LaMarca, A., Landay, J.A., LeGrand, L., Lester, J., Rahimi, A., Rea, A., Wyatt, D. "The Mobile Sensing Platform: An Embedded Activity Recognition System". IEEE Pervasive Computing. Volume: 7, Issue: 2., pp. 32-41 (2008).

[10] Tecnológico Fundación Deusto.: ZAINGUNE Project Web Page, http://www.tecnologico.deusto.es/projects/zaingune, (2008).