AUGMENTED HEARING FOR ELDERLY PEOPLE

Wulf LINDA[1], Garschall MARKUS[1], MANFRED TSCHELIGI[1,2]

ABSTRACT

*In this contribution, we present the project AHEAD - **A**ugmented **H**earing **E**xperience and **A**ssistance in **D**aily Life- which aims at developing a speech-based hearing glasses system extended with assistive services. The key feature of AHEAD is the voice-user-interface (VUI) embraced with a microphone and communication components enabling speech-based system interaction. Additional intelligent sensors for vital-sign measurement as part of the health-related service ensure an improved self-management of health.*

Keywords: hearing glasses, speech-interaction, elderly people

1. Introduction

With increasing age eye sight, hearing, memory and coordination skills decrease. The use of assistive technology systems can help maintaining or even improving the quality of life of elderly people. Assistive technology has the potential to support them to continue living an independent life despite of physical changes. To meet the requirements of physical changes in older age as well as to ensure an easy handling of assistive technology new operating and interaction concepts are needed.

Against this background, we present the European research project AHEAD - **A**ugmented **H**earing **E**xperience and **A**ssistance for **D**aily Life – which aims at providing a speech-controlled assistive system that supports elderly people in their everyday life as communication tool, e.g. initiating phone calls and healthcare manager, e.g. recording vital-sign parameters, initiating emergency calls, medication intake reminder, etc.

Within this project our goal is it to investigate the potential of speech-based interaction for elderly people using a hearing glasses system. Most research activities that have investigated speech-based interaction with elderly people mainly with multimodal user-interfaces such as smart home environments [1] [2] [3] or Living Home Centers [4]. These studies have revealed two relevant insights: On the one hand the results showed that elderly people appreciated the idea of "speaking to a

[1] AIT Austrian Institute for Technology GmbH, e-mail: {linda.wulf.fl, markus.garschall, manfred.tscheligi}@ait.ac.at
[2] ICT&S, University of Salzburg, Salzburg, Austria, e-mail: manfred.tscheligi@sbg.ac.at

home" and that multimodal voice- and touch-enabled interfaces allow an easier use of technologically complex devices and services as well as improve electronic and social inclusion of elderly users [4]. Ferreira et al. [2] performed a user evaluation of a multimodal medication assistant for elderly users based on a smartphone. Their study showed that interaction through spoken language and recommendations given by a medication assistant evoked a positive impact on elderly users.

The mentioned studies, involving elderly people, investigated multimodal user interfaces mostly applied on a smart phone or tablet. To our knowledge there are no studies that have evaluated the elderly people's use of hearing glasses. We can conclude that speech interaction as unique input modality without touch or keyboard/mouse interaction has rarely been investigated and least of all with elderly people.

Therefore, our project will extend the current state-of-the-art by integrating technological components into common everyday objects (in this case: eyeglasses and hearing aid) enabling an unobtrusive way to interact with a system. The hearing-glasses enable the user to receive relevant information via speech-interaction, which can help to master everyday life in an easier and less complex way.

3. The AHEAD system

The hearing glasses are equipped with intelligent sensors for vital-sign measurement as part of the health-related service that ensures an improved self-management of health. The AHEAD hearing aid will be able to measure vital signs such as heart rate, body core temperature and oxygen saturation through sensors that are located in the inner ear and transmit these data for further analysis helping elderly people in self-managing their health. Finally a 3D inertial sensor will record general physical activity and risky behavior. The AHEAD assistant is wirelessly connected to a smart phone and part of a smart living environment. By this, the AHEAD system allows ubiquitous and non-obstructive monitoring services such as triggering emergency calls**.**

Another novel aspect of the AHEAD system constitutes the application of ontology-based context management with the OpenAAL[2] middleware (based on UniversAAL reference architecture). The middleware enables a simple implementation, configuration and situation-dependent provision of flexible, context-sensitive and customized assistive services. The aim of the middleware is to provide relevant background information to all stakeholder groups accelerating the development and introduction of innovative AAL solutions. This enables us to involve different user groups of primary and secondary users (family members, friends, health-care professionals) to enhance the communication and to improve the cooperation between these user groups for an advanced health-care management.

[2] http://openaal.org/

Furthermore other stakeholders, .e.g. hearing aid acousticians will be integrated into the development process and service delivery to guarantee a holistic usability and accessibility of the AHEAD system and related services. Throughout the project's research activities will be performed involving elderly users and other stakeholders.

4. Research Activities

The following section reports the implementation and results of the research activities.

4.1 User Requirements

To ensure the acceptance of elderly users for the AHEAD system we first conducted a user requirements analysis involving 38 primary users, aged between 51 and 87 years, to explore the preference and suitability of different features and the developed use cases.

The participants had to evaluate the proposed use cases according to their usefulness (0= very useless – 10= very useful) in everyday life.

The best evaluated use cases were the emergency call function (Mn=8.92), the health care monitoring function (Mn=8.16), the oven/window warning system (Mn=7.55), the phone call function (Mn=7.5) and the drinking reminder (Mn=7.44). By this, we were able to identify the *must-have* features for low-fi AHEAD prototypes that will be applied in first lab evaluation involving also elderly users. Other uses cases with middle values were the medicine intake reminder function and the finding assistant. Considered as less useful use cases were for example the camera, weather information function and public transport assistant.

4.2 Focus groups

Focus Groups were also performed in Austria and Germany. In Austria 4 nurses and one managing director of mobile home care attended as formal caregivers at the focus groups. In Germany informal caregivers, family members (n=12) and formal caregivers, hearing aid acousticians (n=4) participated at the focus groups.

The results of the focus groups showed that the attitude of the secondary users group (health care staff) was less positive compared to the primary user group. The focus group members mostly doubted that the hearing glasses system could be easy to use and to handle by the elderly users. Another concern was related to the proposed medical services like medicine intake reminders and vital signs measurement. These features were considered to be too unsecure in terms of reliability. The only service that was appreciated was the reminder function if the user would leave the house without the keys.

The focus groups with family members showed a rather positive attitude towards the hearing glasses system. They especially appreciated the integrated communication service that enables direct contact to the primary users as well as the vital sign measurement. Additionally they stated that the control of the system's

configuration should be in the hand of the primary user. Most of the family members stated to use the AHEAD system too if someone from their age group would use it as well. The focus group with hearing aid acousticians underlined the beneficial effect of such a system for the life of elderly people in particular when it comes to emergency situations and health care support.

3. Conclusions

The results of the user requirements analysis revealed a positive attitude towards the proposed AHEAD system by primary and secondary users. The most preferred feature was the emergency call function, followed by phone call, health care monitoring functions and the warning system (open window/running stove). The majority of the primary users indicated to possibly use such a system in future. For the focus groups the results were more heterogeneous. The attitude of the secondary users group (health care staff) was less positive compared to the primary user group. The focus groups with family members showed a more positive attitude towards the hearing glasses system. They especially appreciated the integrated communication service that enables direct contact to the primary users as well as the vital sign measurement. The focus group with hearing aid acousticians underlined the beneficial effect of such a system for the life of elderly people in particular when it comes to emergency situations and health care support.

We can conclude that the proposed voice-controlled hearing glasses extended with assistive service is a very promising system that has the potential to add additional value to the lives of elderly people taking advantage of ICT use. The results of the user requirement analysis will directly be integrated into further developing and optimization processes of the hearing glasses prototype. Future work will target at user-studies evaluating first low-fi prototypes by elderly participants to guarantee user-tailored system which meets with the needs of elderly users. Following this user-centered approach will enhance the overall acceptability of the hearing glasses system by the future user.

R E F E R E N C E S

[1] *Callejas Z., Lopez-Cozar, R,.* “Designing smart home interfaces for the elderly”, SIGACCESS Newslett 95, 2009

[2] *Ferreira, Flavio, et al.,* "Multimodal and adaptable medication assistant for the elderly: A prototype for interaction and usability in smartphones." Information Systems and Technologies (CISTI), 2013 8th Iberian Conference on. IEEE

[3] *Lines L., Hone, K.S.,”* Multiple voices, multiple choices: older adults’ evaluation of speech output to support independent living”, Gerontechnol J, **vol.5**, no. 3, 2006, pp. 78–91

[4] *Pires, Carlos Galinho, et al.* "Living Home Center–A personal assistant with multimodal interaction for elderly and mobility impaired e-inclusion." Proc.PROPOR. Coimbra. 2012.