Hearing Aid Technology and Multi-Media Devices

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Abstract

Hearing impairment is a growing problem for our ageing communication society. Although many elderly people take notice of their hearing deficiencies in daily communication, only few of them are supplied with hearing aids. This maybe a cause of several psycho-social factors (e.g. stigmatization, comfort, cost and effort) associated with hearing loss .
The Hearing at Home (HaH) project [1] tries to tackle this general acceptance problem by applying supportive hearing technology into (highly accepted) home-entertainment devices, allowing the elderly people to participate in communication without using hearing aids. It is anticipated that formerly separated devices like TV, telephone, fax, intercom, personal computer, HIFI systems as well as services like VoIP and home automation grow together and can be integrated into a single Home Information and Communication (HIC) platform accessible and controlled through a TV set. The HIC platform that is researched and developed in HaH will support the hearing impaired with easy to fit Supportive Audio Signal Processing (SASP) and visual support for lip-reading on the TV screen [2]. In this contribution the developments and results of the HaH project will be presented and discussed and an outlook on future Ambient Assisted Living (AAL) related projects, including low-threshold man-machine interfaces will be given.

1. Motivation and Aim

The demographic change in the European Union leads to a strong increase in the number of hearing impaired people. From the age of 40 onwards the sense of hearing begins to degrade and estimates indicate that more than 50% of people over the age of 60 have a noticeable degree of hearing loss. In a study accomplished in the U.K. by the Institute of Hearing Research (IHR) it was estimated that in 2005 more than 81.5 million adults in the EU have hearing problems and that this number will increase to 90.6 million by 2015. This figure indicates that more than 14% of adults in Europe will have hearing problems.
On the other hand, many hearing-impaired people have reservations about wearing conventional hearing aids and thus decide to stay unaided. Only about 23% of hearing impaired that would benefit from a hearing aid actually use one [4]. However, the integration of assistive listening technologies in home entertainment and communication electronics might increase the user's willingness to be aided in general.
Thus the hearing at home project (HaH) aims at integrating audio-visual hearing support technologies within common digital TV/Set-Top-Box (STB)-like Home Information and Communication (HIC) platform devices. This way, the acceptance barrier is lowered to a minimum.

2. Setup and Scenarios

The HIC platform is connected to communication devices (Phone, VoIP, Video Phone) and to multimedia (TV, DVD, Radio, etc.), see Figure 1. Additionally, it can communicate with several home appliances (doorbell, oven, washing machine, etc.) via home automation networking. The control and handling of all signal streams is done by the Multi-Services Home Platform which is an OSGi-based software architecture for residential gateways developed by OFFIS (for a list of the project partners see [1]). All audio signals are processed within the Master Hearing Aid (MHA, developed by HörTech) [3] which is a PC-based audio signal processing platform. The processed output audio signal is visualized by a computer-animated talking head (SynFace, developed by KTH [2]) to provide lip-reading support. The audio signal processing done in the MHA is divided into a global Supportive Audio Signal Processing (gSASP) part that provides algorithms for noise reduction and signal classification, and an individual Supportive Audio Signal Processing (iSASP) that provides user-dependent algorithms like, e.g., dynamic compression. The iSASP can be fitted individually with a wizard-guided fitting procedure. However, an initial setup may also be applied with the help of a professional.
The HaH project addresses three different scenarios which are typical for situations at home. A typical phone communication scenario, a scenario that demonstrates the handling of TV, video and radio media and a home automation scenario (for the integration of different sensors like doorbell, oven, etc.) will be realized and evaluated.

In all scenarios, the audio signals can be enhanced by the MHA and visually presented using the SynFace technology for lip-reading support. The benefit of the Supportive Audio Signal Processing schemes and the SynFace are currently evaluated in extensive user tests with 80 hearing-impaired subjects. The integrated overall systems (i.e. the HIC platform) will be evaluated by user tests at a later stage of the project in 2009.

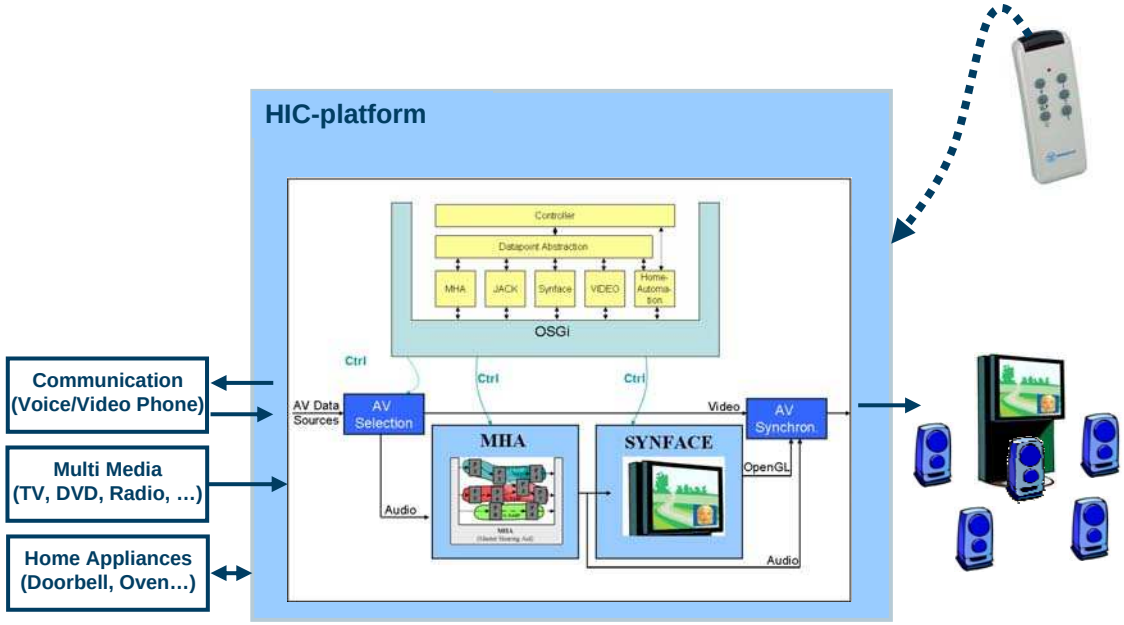

Figure 1: Communication scenario based on the Home Information and Communication (HIC) platform. Signals are input from different communication channels (phone, VoIP, Intercom), processed using the Supportive Audio signal Processing (SASP) and output to the communication device (e.g., headset or phone receiver). In parallel, an animated synthetic face is rendered for supporting lip-reading.

3. Outlook

In the HaH project it is anticipated that all signal processing and man-machine communication (MMC) is realized within a single HIC platform which is accessible through a TV-Set. However, while it is reasonable that the information of different input/output signal streams are processed in a single host, a distributed (or decentralized) MMC through existing interfaces (HIFI, TV, Phone, built-in visual/acoustic sensors) at different places in a household would most probably offer a more comfortable and transparent way to access assistive systems. These even more complex ambient scenarios bring up additional problems which may require speaker localization, event detection, context evaluation or signal enhancement for distant talk situations. Recently, the GAL-project has been launched within a Lower Saxony Research Network on the Design of Environments for Ageing to find new approaches to these problems. In this contribution we will present first progress of the GAL project in event detection, speaker localization and noise reduction and discuss these based on the results of the HaH project.

4. References

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