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SHiEC

Supporting Hearing in Elderly Citizens

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Supported Hearing in Elderly Citizens

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Title:

Sound Processor Diagnostics

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Type of Deliverable: Restricted

Introduction

This deliverable concerns the task 1.6 of the SHiEC (Supported Hearing in Elderly Citizens) working plan. The task definition is "***Task 1.6 Sound processor diagnostics*** *Recipients are "off the air" often for small technical problems. These can be related to a degraded performance of the microphone, battery issues, … They need to come to the clinic to analyse and correct these issues. In this task we will investigated specific and sensitive tests that can be performed reliably in a home environment (on a tablet computer) to perform to diagnose at home, potentially triggered by the clinician*."

The sound processor of a cochlear implant (CI) is the external part of a cochlear implant system. Figure 1 shows the system components in more detail. The sound processor performs the following functionalities

- Sound capture through a dual microphone
- Selection of other sound inputs such as assistive listening devices: telecoil (room loop system), wFM system (speaker at a distance), or other wireless accessories
- Selection of the map, i.e. the program running on the sound processor
- Sound preprocessing, such as directional beamforming, wide band dynamic gain compression and noise reduction
- Sound frequency analysis
- Electrical stimulation calculation
- Radiocommunication to the implant via the telecoil antenna

Figure 1: A cochlear implant system consists of an internal part (the implant) and an external part, a sound processor worn on the ear (BTE- Behind The Ear processor). The right part of the figure also shows the remote control unit.

Cochlear implant users can no longer hear optimally when their sound processor is no longer functioning well. This may happen because the processor is

- down due to a battery problem
- the microphone is not functional well
- the microphone volume is too soft
- the processor is in an unwanted state (e.g. listening to a telecoil)
- the processor is not in the optimal map configuration

It is not easy for a senior user to diagnose the cause of a problem. E.g. for a volume change or a map change, the processor has integrated buttons. But often users, and certainly elderly users that already have some dexterity or vision difficulties, then have to take their processor of the ear in order to press the correct buttons.

To enable the users to perform these actions without removing the sound processor from their ear, currently users can select a remote control unit, as shown in Figure 1. The small unit can only be used for volume control and map changes, the most basic operations. The bigger unit – the remote assistant – has a larger screen and provides finer control over the processor, a visualization of the instantaneous sound environment and processor setting and various status checks. The user has to scroll to various screens with the buttons to access this functionality.

Many senior users prefer the small remote control. The bigger remote assistant has more functionality, but is more complex to handle.

Description of the demonstrator

In task 1.6 we have worked on the topic of an app with rich functionality to control the sound processor. The work consists of two parts.

a) A first deliverable is an app that is compatible with the current generation of sound processors and implants.
b) A second deliverable is the design of a user interface of an iPhone app that is only compatible with the next generation of sound processors.

Demonstrator – Part A

The first demonstrator consists of a clinical app on a tablet to read and control the sound processor of a cochlear implant. Currently the clinician is programming the sound processor by opening a program (Custom Sound) on a desktop computer. The computer is connected to sound processor through a programming cable (the pod). Through this link the clinician can set the stimulation levels, read out the implant and sound processor diagnostic values and read out the data logs.

For patient and clinician it would be so much easier and comfortable if the patient is no longer wired to the computer, but can move freely. In this task we developed a tablet application for the clinician to control the sound processor. Direct wireless connectivity with the sound processor will only be possible in the next generation sound processors (Nucleus 7) because new chip sets are needed (low energy Bluetooth). For now a cable connection is still required. Therefore we selected an Android tablet which has a USB connector. The software was then developed to communicate from Android over this usb link to the processor, a driver was developed, and a prototype clinician application. For the clinician application, C++ and Qt – a cross-platform GUI - were used.

The functionalities in the demonstrator allow to connect from the tablet to a Nucleus 6 processor and then

- Establish the connection
- Select a map out of the four possible slots
- Adjust the map parameters (threshold and comfort level, …)
- Set volume and sensitivity

- Monitor stimulation levels
- Read the data logs

The purpose of this technology demonstrator has been on verifying the underlying software technologies that are needed to communicate with the processor from a tablet device.

See the movie: SHiEC_D15_movie_partA.m4v

Figure 2: movie demonstrating a real-time connection from a tablet computer (Android) to the sound processor. The application is a clinician application (fitting the device parameters for a particular patient).

Demonstrator – Part B

The next generation Nucleus sound processors will have the chip sets to communicate directly with an iPhone. Therefore this is the right moment to start working on an attractive interface for the first generation of apps.

Multiple concepts for the user interface (UI) have been proposed, with different styles and color schemes. CI users were included in the evaluation of the different concepts. A final concept has been selected. Some aspects of the UI are shown in Figure 3. The user interface provides access to the most requested functionalities in an attractive and easy to use design, which is not possible with the current remote assistant.

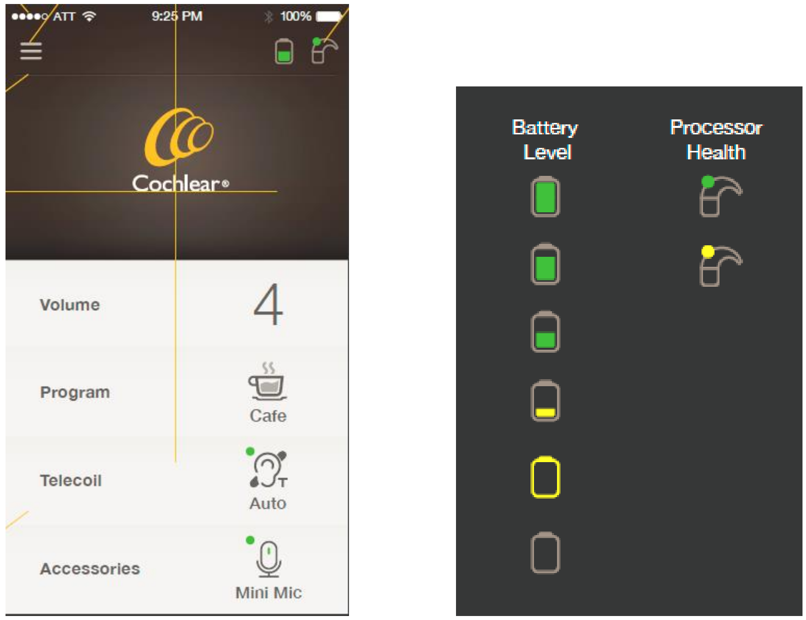

Figure 3 UI concept for a user app to control the CI sound processor.

A demo of the new UI has been developed and implemented on Apple SmartPhone. It is shown in the movie SHiEC_D15_movie_partB.m4v. The full functional implementation of the user interface has been started (see Cochlear technical document 504821 Functional Design Description Diagnostics and Datalogging)

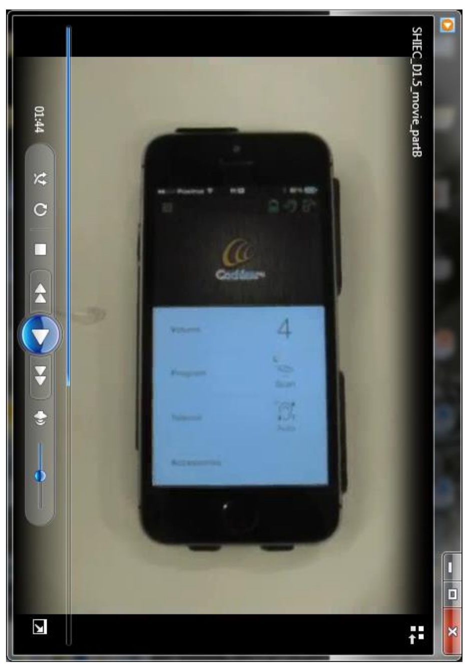

Figure 4 Video demonstrating the design of the user interface for a smartphone application for the recipient. This allows the user to control and monitor his device.