

A Bluetooth-Based Wireless Phone Adapter For Cochlear Implant Users

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Introduction

- Although several telephone assistive listening devices were developed for hearing-aid users, not many assistive devices were developed for cochlear implant (CI) users.
- Besides the telephone adapter, which directly connects the implant processor to the telephone, CI users do not have many other options.
- The major disadvantage in using a direct-connection telephone adapter is that it limits the CI users' mobility as it confines them to be near the telephone jack.
- In this study, we report on the development of a prototype wireless phone adapter based on Bluetooth wireless technology.

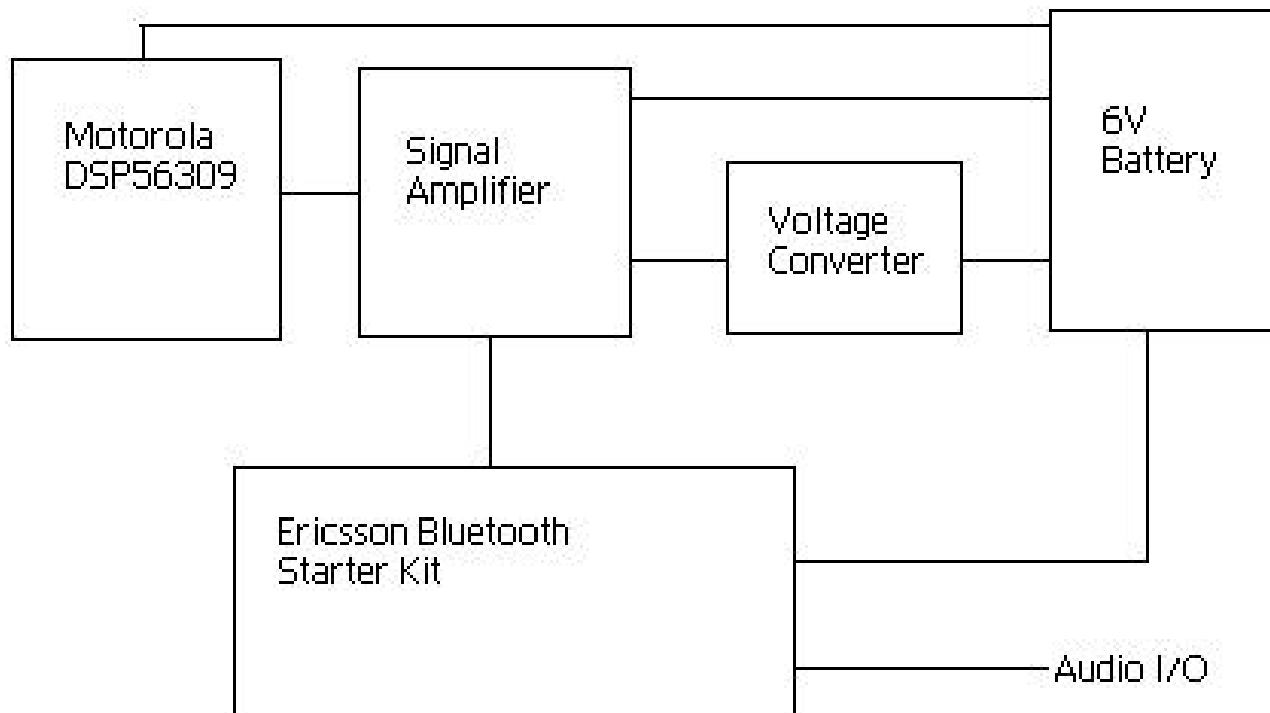
Bluetooth Technology

- A short-distance wireless communication standard. Employs radio frequencies in the 2.4-2.5 GHz band which is available for public use.
- Replaces all cables.
- A large number of bluetooth-enabled devices including cellphones, laptops, printers, PDAs will be available in the near future.
- People carrying a personal bluetooth device, can automatically find local bluetooth-enabled devices and make use of information and services provided.

Prototype System

- This prototype is based on Ericsson's Bluetooth Starter Kit (EBSK) which works with a host controller.
- For portability purposes, a Motorola DSP is programmed to generate the proper control signals.
- In order to meet the electrical requirements of the host interface of the EBSK, a signal amplifying and shifting circuit was designed. A voltage converter circuit was added to provide the negative voltage required.

Hardware Architecture



Operation

- When the device is powered up, the program stored in the DSPEVM flash memory is loaded and executed, generating the desired signal.
- The signal passes through the amplifying circuit, amplified and shifted to the proper voltage values. Then is sent to the host interface of the EBSK.
- The EBSK executes the set of commands contained in the signal, which sets the Bluetooth chip to a 'slave' mode, waiting for a connection request of a 'master' device.

Operation (cont-ed)

- A sequence of 9 Bluetooth Host Controller Interface (HCI) protocol commands was implemented in this device.
- Their function is to reset the EBSK, to set basic transmission settings, and to put the EBSK in a “slave” mode waiting for connection.
- The Motorola DSP56309 EVM is used as the host controller in this device. The host I/O port is used to send the desired signal to the EBSK.
- To make the system portable, the assembly code is stored in the flash memory of the EVM, and is executed whenever the DSP is reset.

Testing

- The prototype system was tested with 4 Med-El/CIS-Link users using live voice.
- The output of the system was fed into the auxiliary jack of the CI processor.
- All subjects reported good quality through the Bluetooth-enabled device. Quality was as good as using a direct-phone cable connection.

Next Step and Work in progress

- We are currently working on interfacing our prototype system with a Bluetooth-enabled cellphone. We are using Ericsson's T28W cellphone equipped with the DBA10 Bluetooth adapter.
- Based on the software stack from Ericsson, we wrote a program to implement a headset profile. This program runs on a PC, controls the EBSK, and can talk to any bluetooth-enabled device.
- Our application program implements the function of a headset, by sending commands and receiving messages from the protocol stack.
- With this program, other bluetooth-enabled devices (e.g., cellphones, PDAs) can find our device as a headset and send the audio input and output to the CI processor and the microphone.

Conclusions

- A prototype wireless-phone adapter was built and tested successfully with CI users.
- This project demonstrated the potential of Bluetooth technology in improving the life of CI users.
- Using Bluetooth technology, CI users will be able in the near future to use cellphones anywhere and at anytime, **no matter how noisy the background environment is.**