ANDROID-BASED RESEARCH PLATFORM FOR COCHLEAR IMPLANTS

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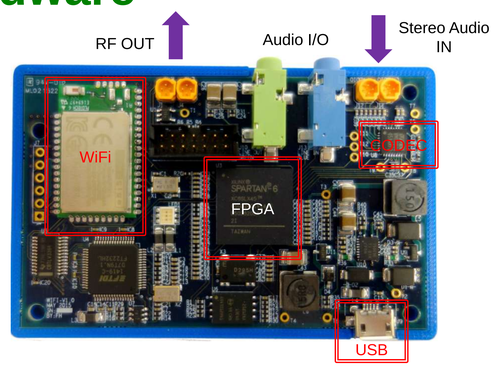
Cochlear Implant Laboratory

1. Highlights/Features

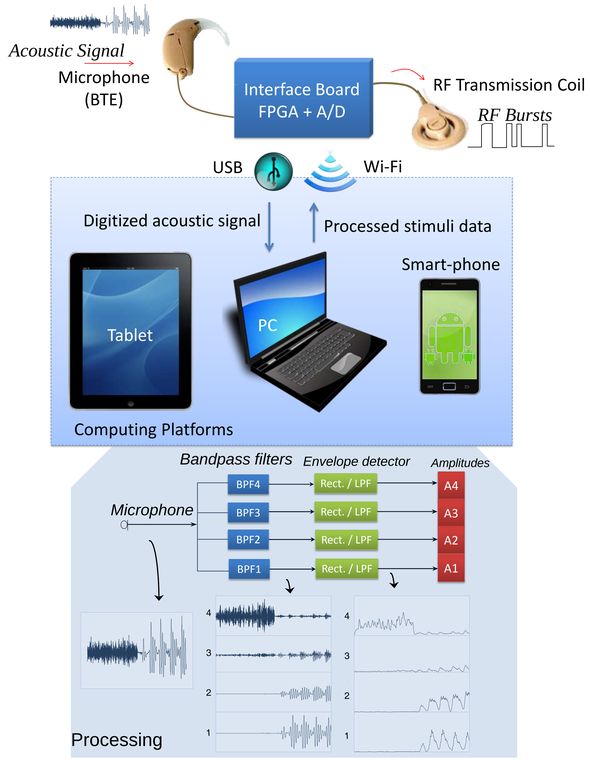
- General purpose portable sound processing research platform that is an extension of UTD-PDA CI interface and is based on existing and emerging hand-held Android-based smart-phones and tablets.
- Compatible with cochlear implants manufactured by Cochlear Corporation.
- Supports unilateral, synchronized bilateral electrical stimulation and electric + acoustic stimulation (EAS).
- Supports Two Operational modes:
  - **Real-time:** Similar to a clinical body-worn processor to conduct experiments in free field. Smartphone/tablet acts as a processor. Suitable for take-home field trials.
  - **Bench-top:** allows platform to be used in bench-top (offline) mode to conduct experiments in laboratory (using MATLAB).
- Flexibility in implementing novel signal processing algorithms as Apps.; potential for future advancements/expansion using Android

2. Hardware



The platform consists of a smart-phone/tablet for implementing and evaluating novel sound processing algorithms and a custom-developed interface board to stimulate Cochlear Corporation's CI24 implants. The interface board houses a high quality stereo audio codec, an FPGA, a Wi-Fi module, and a set of input/output ports for connection with clinical Behind-the-Ear (BTE) microphone units, and Freedom headpiece coils

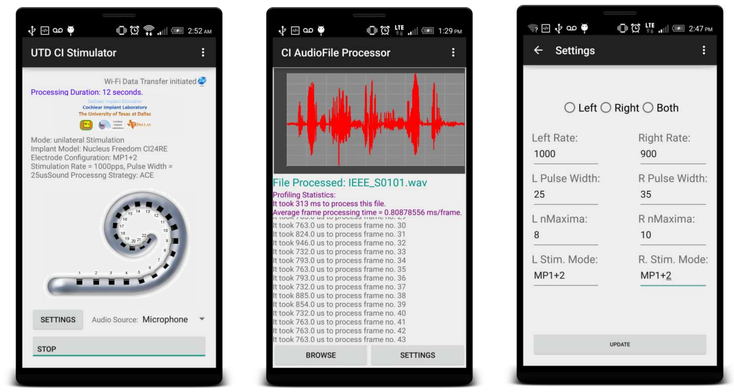
3. High Level Diagram



- The acoustic signal is first acquired from the BTE and is sampled digitally by an on-board stereo codec and sent to the smartphone wirelessly over Wi-Fi for subsequent processing.
- The smartphone receives packets of stereo acoustic data every 8 ms, and processes them through a sound coding strategy.
- As a proof-of-concept, Advanced Combination Encoder (ACE) strategy has been implemented.
- The processing generates a set of stimulation data which consists of electrode, mode, amplitude (EMA), and timing of each biphasic pulse. The stimulation data is sent back to the interface board where it is encoded in the embedded protocol by the FPGA, and finally streamed to the Freedom coil for stimulation.

4. Software

- Real-time software written in JAVA – processes stereo acoustic signal and produces a stimulation sequence as determined by the sound coding strategy every 8 ms.
- Touch-screen interface and interactive UI controls on the smartphone offer the ability to change stimulation parameters on the go with great flexibility; offers real "field processing" support in naturalistic spaces.
- Multi-core processors provide high computational power for complex, time intensive signal processing algorithms.
- Researchers have the flexibility to write their own code, as well as develop custom programs/apps. Reference Apps available in the Google Play App Store.
- Bench-top software written in MATLAB and can be used to conduct studies in the laboratory environment.



5. Conclusions

- A general purpose portable CI research interface with flexible and scalable software infrastructure to accommodate new features and address multitude of research needs.
- Can be used in laboratory for bench-top testing or everyday environments as a body-worn processor for field trials.
- Open source software with reference apps. Software libraries will be provided to extend support to other mobile platforms such as Apple OS (iphones), and windows-based cell-phones.

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