Introduction

EEG systems currently used in medical institutions are restricted in their application due to several physical limitations. One such limitation involves the signal artifacts created by movement of wires; even small movements of wires within the generated magnetic field causes artifacts of considerable magnitude. As these artifacts obstruct any analysis of procured EEG waveforms, the prevention of these artifacts would significantly improve the ability of medical professionals to perform accurate studies. Consequently, a system in which each electrode functions as a node in wireless mesh network was developed and proposed as a method to eliminate this problem by removing the need for wires altogether. Due to the infeasibility of designing such a device to meet all medical standards with the allocated resources, a proof-of-concept system was implemented with the expectation that future iterations would be miniaturized. Ideally, the system will be small enough to be subdually implanted in order to improve signal quality. Furthermore, this facilitates long term studies as it is an unobtrusive solution.

Design Objectives

- Design of two-channel analog EEG amplification and filtering board
- Design of wireless communication software architecture based on mesh networking topology
- Design of software for real-time acquisition and display of digitized EEG signals obtained from the analog circuit
- Integration of analog and digital systems into a single-supply, low-power device

Analog Design

The analog board acquires EEG signals via passive electrodes from a human subject and processes them through a cascaded amplifier and filter topology as shown in the flow diagram below. The analog design is based on the OpenEEG platform. The schematic is implemented on a two-layer PCB that outputs the processed EEG signals to the ADC on the TelosB.

Digital Design

The output from the analog hardware is sampled for digitization and wireless transfer to a base station PC. For this process, a TelosB wireless hardware platform is chosen. With its on-board ADC and processor, the analog waveform is captured and encapsulated into transferable packets. A user interface program is created in Java to handle network management and data collection on the base station PC.

Results

A simulated EEG input of magnitude 1000µV is applied to the amplifier input. The processed signal is wirelessly transmitted to the base PC and reconstructed. The input and reconstruction are shown.