Project Synapse
A Portable, Affordable, and User-Friendly EEG Device to Monitor and Study Neural Activity During Sleep
Professor Pai H. Chou, Department of Electrical Engineering and Computer Science

Background
EEG machines for sleep study are large and not accessible for home use. Collecting neural activity during sleep requires the patient to go to a specialized sleep study center for monitoring. For many people, a sleep study lab is not an ideal setting for getting a typical night’s rest. As a result, the data retrieved would not give an accurate representation of a patient’s neural activity during sleep. We aim to solve this problem by creating a low cost, portable EEG device that will connect to a user’s smartphone to process, log, and display data. Other companies have portable EEG devices that connect to smartphones, but they are typically not usable during sleep. One device, the Emotiv, uses a hard plastic structure. This would be uncomfortable or perhaps unusable during sleep. We will use a comfortable and flexible headband. Other portable EEGs that are usable during sleep are expensive (upwards of $1500). We aim to keep our product under $200 in order to make it accessible to as many people as possible.

Our Solution
A single board solution that will have a 2 channel EEG to keep costs low and have a manageable amount of data to start with. Each one of the channels will monitor one of the hemispheres of the brain. A later version of our product could be expanded to more channels as needed. The Android application will be used to display the data from the EEG headband.

Innovation in Design
A comfortable low cost, EEG at an affordable price, that can be used during sleep. It wirelessly connects to any android device that has the app installed, which will be used to display the data collected by the device. In addition, it can record current data and playback any saved recordings.

Major Components
Sensors:
Four electrodes attached via headband (2 Channels, 1 Bias, 1 Reference).
Data Acquisition:
EEG Analog Frontend ADS1299. eight channel, low power, analog to digital converter for EEG applications. 24 bits per sample.
Power Supply:
Low dropout regulators that are suited for low-power mobile devices.
3 AAA rechargeable NiMH batteries (1.2V, 750 mAh each)
Android Application:
Receives samples via Bluetooth Low Energy. Processes samples to separate data into different brain wave frequencies. Logs data to be reviewed or transmitted later. Allows data to be viewed on a graph.

Schedule
Week 4: Complete Design for Final Prototype PCB and sent for Fabrication
Week 6: Finalize Android Application Prototype.
Week 8: Complete Hardware Build and Test.
Week 9: Complete Testing and Data Characterization
Week 10: Oral Presentation.
Week 10: Final Report Submission.

Progress/Results

Contact
Team:
Aaron Adamski, aadamski@uci.edu
Alex Opru, aopru@uci.edu
Charles Lam, cklam1@uci.edu
Steven Bui, stevenb1@uci.edu
Mentor:
Pai Chou, phchou@uci.edu

Designed PCB from Fab
Testing the board with a logic analyzer
Rev2: EcoBT and 1299 Prototype
Finalized Product Casing

Android Application in Action
Square and Triangle Waveforms
Chip Signal from Logic Analyzer