Wireless Sleep Monitor

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Introduction & Objective

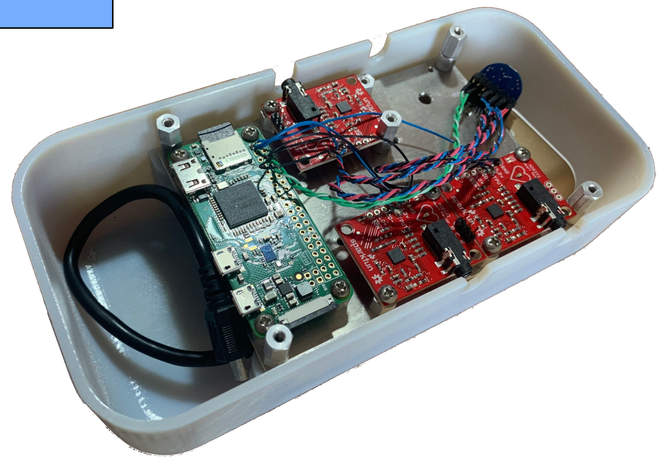
Many Americans struggle with sleep disorders and even more struggle to sleep well. In-lab and home based sleep studies record useful information about a patient during sleep but are often expensive and uncomfortable processes. Our project aimed to build a more affordable wireless sleep monitor. Our monitor was based off of a subset of the equipment used in a Polysomnography, the primary in-lab sleep study. The device, strapped to the patient, records EEG and ECG data which is wirelessly streamed to a server where it is recorded, and could be presented to a physician to be analyzed.

Components

1. AD8232

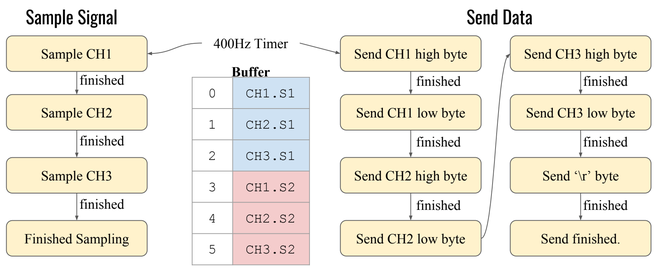
The first component of our design includes three SparkFun PCB boards that include AD8232 ICs which are needed to detect bioelectric signals.

- 2 of the channels have increased gain and can be used for collecting EEG signals
- 1 of the channels is used for collecting ECG signals.



2. MSP 430

The amplified output of the PCB channels is sampled at 400Hz by a MSP430f2013 microcontroller which has a 16 bit sigma-delta ADC. The microcontroller then uses its SPI module to send data to the Raspberry Pi's UART.



MSP430 Software diagram

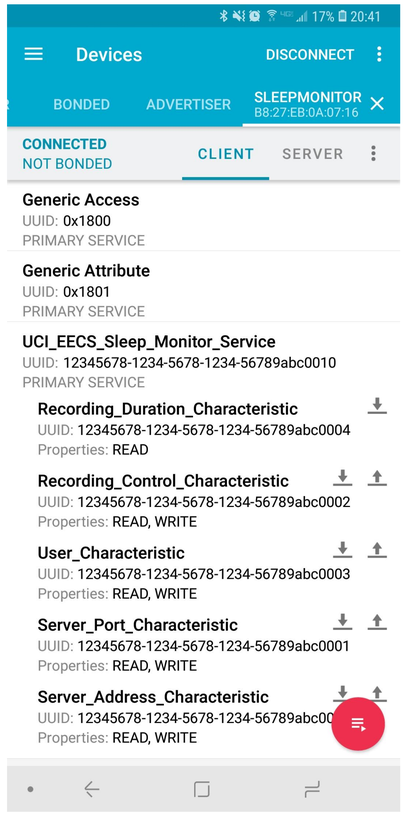
3. Raspberry Pi

The third component of our design features a Raspberry Pi Zero W which is responsible for:

- Powering the AD8232s boards and receiving data from the MSP430.
- Connecting to a local WiFi network for packaging of signal samples and wirelessly transmitting data in real-time to a designated server.
- Beginning and ending recordings via bluetooth low energy.

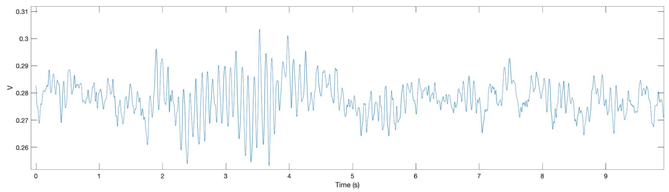
Performance

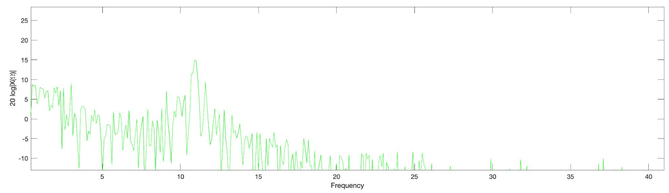
Wireless Control



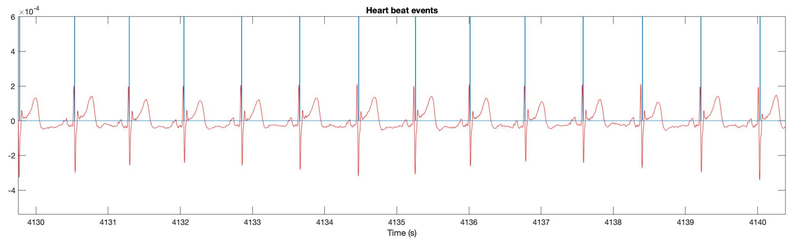
Raspberry Pi communicating over bluetooth low energy

Collected EEG and ECG Data





Posterior Dominant Rhythm at approximately 12Hz signal.



Heart beat detection used to compute a heart rate.

Our Team

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Acknowledgements

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Dr. Stuart Kleinfelder	*Our Professor*
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Citations

Louis, Erik K. St. "Electroencephalography (EEG): An Introductory Text and Atlas of Normal and Abnormal Findings in Adults, Children, and Infants." *American Epilepsy Society*.

Parak, J. "ECG signal processing and heart rate frequency detection methods." Czech Technical University in Prague