

EE / CprE / SE 491 – sdmay18-12

Pilot Biometrics - ECG Waveform Captures Week 3 Report

2/9/2017 – 2/23/2018

Client: Rockwell Collins

Point of Contact: JR Spidell

Faculty Advisor: Dr. Tyagi

Team Members:

Ryan Gallus - Team Lead

Justin Bader - Filter Design Lead

Zachary Glanz - Filter Design Lead

Kory Gray - Operating Systems Lead

Andrew Jones - Algorithm Design Lead

David Kirpes - Circuit Design Lead

Weekly Summary

These past two weeks, the team continued work on several important aspects of the project. We were able to get the ECG sensor leads interfaced with both the ADC and the Microcontroller, allowing us to get real data from a human source all the way to registers on the board, which can be accessed in code. We are still working through issues with the current design, where we originally planned on using four ECG leads but only received three from our client. Because of this, we must use one of the three as our voltage reference point until we can get an additional lead. Our Artificial Neural Network for detecting cognitive stress has been entirely coded now, and we are beginning testing with different data sets. We are working on finding a clean labeled data set for training. Finally, we have also finished changes to the power supply to work with a battery.

Past Week Accomplishments

- Communication between ECG leads, ADC, and Microcontroller
 - ECG sensors connected to three channels on the analog to digital converter
 - Serial connection from ADC to Microcontroller writing to registers on the board
 - Registers can be accessed by code
- Post-processing live data from ECG sensors
 - Comparing to sample ECG data
 - Need to determine which lead to use as voltage reference in the three lead design
- Finished Artificial Neural Network algorithm.
 - Started testing ANN for learning capabilities.

- Started looking for training sets to train the ANN.
- Parts arrived for power supply
 - Works with battery source
- Bandpass and bandstop filters designed
 - Exploring option of using filter built into ADC

Pending Issues

- Need to find good labeled data set to train the Artificial Neural Network
 - Ideally use real data from our sensors
- OS boot issue still present
 - Need to finish establishing linux development environment

Individual Contributions

Team Member	Contribution	Weekly Hours	Total Hours
Ryan Gallus	Researched Heart Rate Variability (HRV) as a means of measuring cognitive load. Analyzed sample ECG data from past studies and compared various metrics for HRV, both in time and frequency domains. Also looked at effectiveness of neural net versus other supervised learning techniques.	8	80
Justin Bader	Worked with David towards creating the power supply. Was able to run the microcontroller and ADC off of the power supply that was constructed. Trying to figure out how to get accurate data reads from the ADC as right now the data is gibberish. Seems to be a register is not set correctly but this has been my primary focus the past two weeks.	13	63
Zachary Glanz	Looked into customizing bootable linux image on board to allow control of pins to be involved with SPI to the ADC and for data storage/transmission.	4	79
Kory Gray	Read reports on reducing signal interference from ECG sensor input. Highlighted a few different methods to help clarify the signal received from sensors. Also spent time working on correcting the linux OS boot problem.	6	69
Andrew Jones	Finished Artificial Neural Network algorithm. Started testing ANN for learning capabilities. Also started looking for training sets to train the ANN.	8	64
David Kirpes	I received parts for the power supply so that is built now. Looking for a battery to power the device still. Filters are designed and can be constructed quickly if we are unable to use the filters on the	12	79

	boards. I have also been doing post processing on the data communications to determine if we have meaningful data.		
--	--	--	--

Comments and Extended Discussion

- Driver Stress Detection with Heart Rate Variability
 - <http://ieeexplore.ieee.org/document/7323251/>
- Stress Recognition in Automobile Driver Database
 - <https://physionet.org/pn3/drivedb/>
- Ultra-Short Term Stress Detection
 - https://link.springer.com/chapter/10.1007/978-3-319-19387-8_260

Plans for Coming Week

- Determine configuration requirements to set voltage reference point in three lead design
 - Need proper configuration to get useful data from ECG sensors
- Train Artificial Neural Network with sample data
 - Gather labeled data set from online resources
 - Once ADC and ECG sensors are properly configured, we can produce our own data set
- Establish linux development environment on the microcontroller
- Configure bandpass and bandstop filters on the ADC, or design on breadboard