Team 61: Driver Drowsiness Detection
Bi-Weekly Update 1

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Project Summary

Problem:
Driving fatigue has been a major cause of accidents on the road. Truck drivers are at a greater risk of driver fatigue because of the long hours spent driving.

Solution:
Our Driver Drowsiness Detection System will use a machine learning (ML) algorithm and electroencephalogram (EEG) device to determine a driver's level of fatigue and alert the driver to rest.

Project/Subsystem Overview

EEG

- Filter out unwanted frequencies.
- Take in brain waves in microvolts and amplify them to volts.
- Send data to MCU

MCU

- Receive incoming signals from EEG
- Send data to computer running ML algorithm

Dakota

Simulator

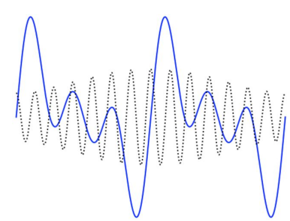
- Collect data
- Muse 2 EEG device

Signal Processor

- Perform live analysis of signals
- Process raw EEG signals

ML Algorithm

- Input processed EEG signals
- Output fatigue state of user



Team 2: Coady and Ali

Major Project Changes for 404

- Lost our team member who was making a custom MCU for our EEG to interface with a computer and the ML model. Has been replaced with a raspberry pi board for programming and computer interfacing.

- Original design for EEG device was going to be made up of four boards, each with two electrodes, however due to budget constraints we will only be using one board initially and if we have enough time then potentially a second board will be added to the system for four total electrodes.

Project Timeline

January	February	March	April
SP/ML Light Integration EEG/MCU Interfacing	SP/ML Live Analysis EEG PCB Complete	System Refinements	System Verifications Integration of SP/ML & EEG (stretch goal) Final Presentations/Demo

EEG Device

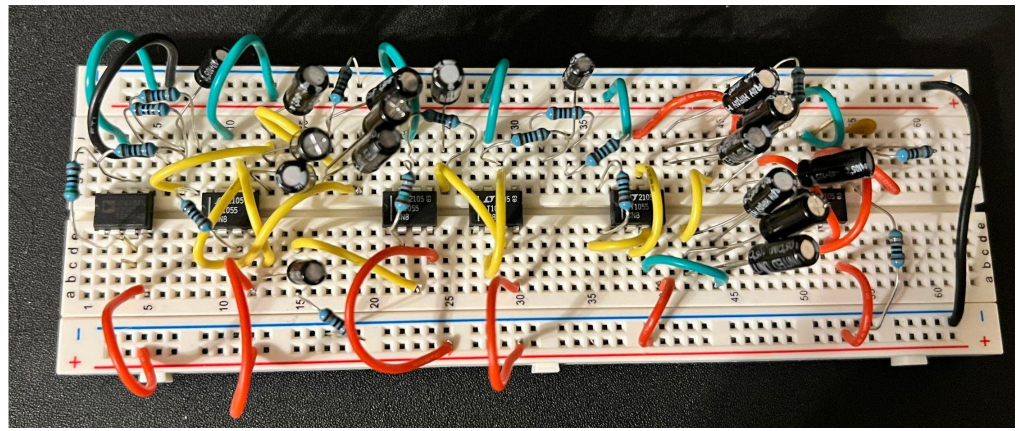
Dakota Mouton

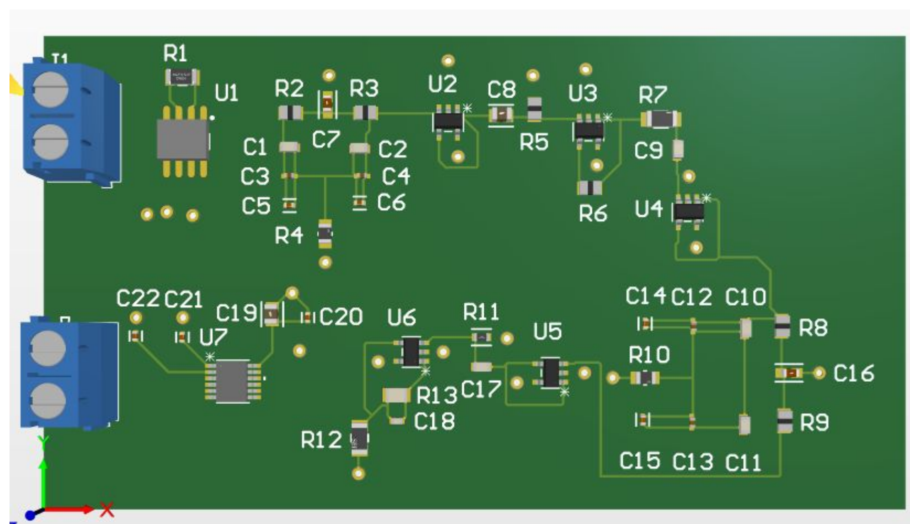
Accomplishments since 403 15 hrs of effort	Ongoing progress/problems and plans until the next presentation
• Reading live signals from electrodes through arduino board.	• Verify the live signals are actually as expected by analyzing signals using FFT. • Finish PCB design, order boards, solder components. • Connect to raspberry pi board for ML model to run with new hardware.

EEG Device

Dakota Mouton

- 5V voltage regulator works using four 1.5V batteries.
- Live signal from electrodes is working and interfacing with arduino board and computer.
- Still verifying that unwanted frequencies are filtered out by the circuit and leaves our target frequencies (8-30 Hz)
- Finishing touches on PCB schematic for it to be ordered.





Signal Processing

Coady Lewis

Accomplishments since 403 04 hrs of effort	Ongoing progress/problems and plans until the next presentation
-Added functionality to support any number of frequency bands of interest. -Tested and verified operation on existing datasets. -Initial tests showed improvement. ~14% on a 2 hour dataset from last semester.	-Will continue to test different frequency band limits on existing data for best results. -Will automate testing process to find best settings for window size, window overlap.

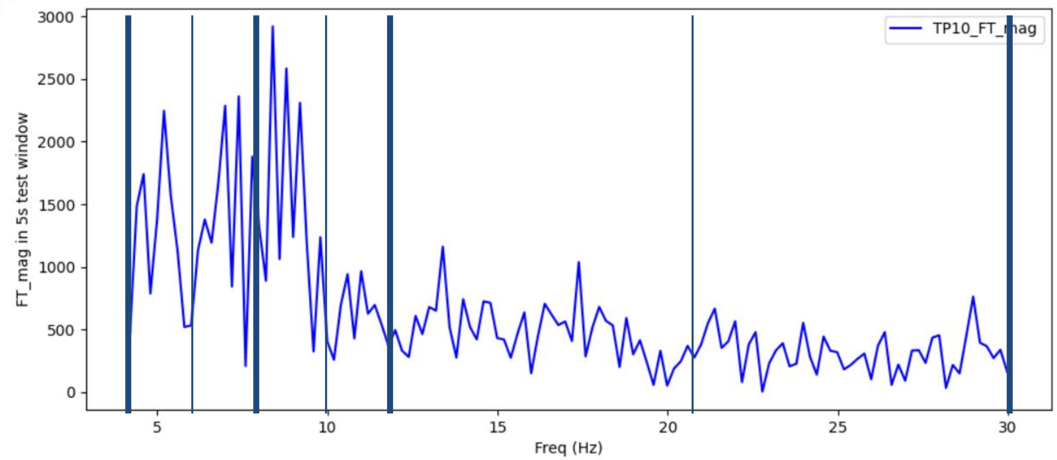
Signal Processing

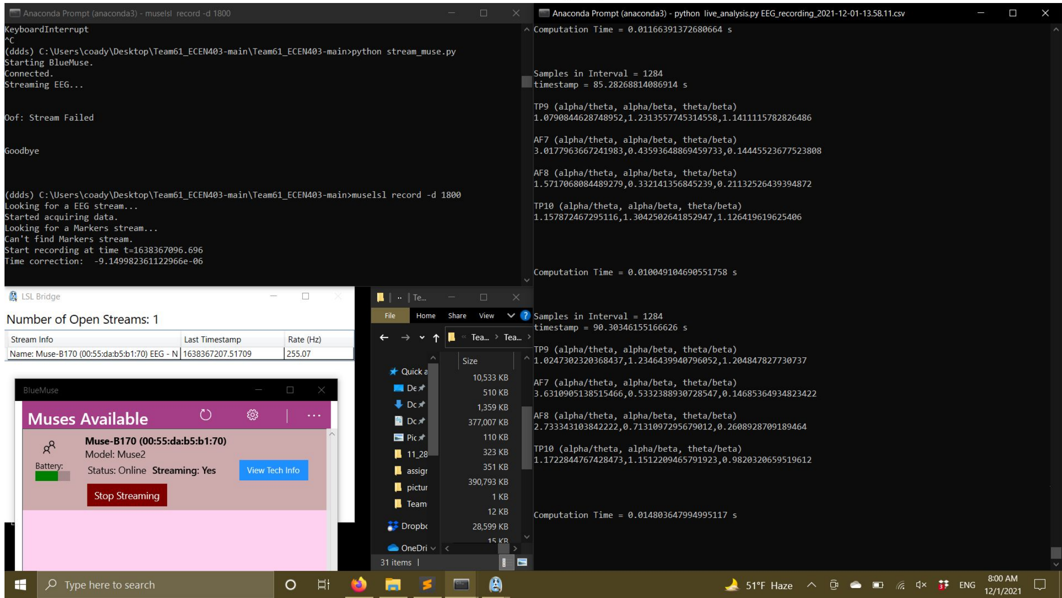
Coady Lewis

-All functions completed last semester still work, including the real-time signal analysis

-Will integrate new improvements to the live analysis

-The cost of more frequency bands is an increase in the data required to tune the model. More collection is needed.





Machine Learning

Ali Imran

Accomplishments since 403 05 hrs of effort	Ongoing progress/problems and plans until the next presentation
- Completed program which takes in raw signal .csv files, runs signal processor through each file, and sends entire processed dataset to train/test ML models	- Collect more training data - Test current models with live analysis

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Machine Learning

Ali Imran

	Dataset		
Model	8 Hours Ali	4 Hours Ali/Coady	Online Dataset
Naive Bayes	71.7	74.6	72.9
Neural Network	78.3	83.5	97.1
Kernel SVM	**83.5**	**85**	**97.3**

New Circumstances:

- Approaching drowsiness
- Testing model on new person

Parts Ordering Status

- EEG Device: All SMD components to be soldering onto the PCB’s are already ordered along with the electrodes. Just need PCB’s to be ordered and the EEG device is done.

Execution Timeline

	1/16/22	1/23/22	1/30/22	2/6/22	2/13/22	2/20/22	2/27/22	3/6/22	3/13/22	3/20/22	3/27/22	4/3/22	4/10/22	4/17/22	4/24/22	5/1/22
Status Update 1																
EEG interfacing with arduino/raspberry pi board										Not started						
Verify EEG hardware reads correct signal frequencies										In Progress						
Finish PCB design and order boards										Completed						
Write SP/ML integration program for training models										Behind Schedule						
Status Update 2																
Solder components onto PCB's and verify proper function																
Verify PCB's interface with arduino/raspberry pi board																
Write SP/ML integration program for live analysis																
Record live analysis ML model accuracies/results																
Record live analysis ML model with multiple people																
Status Update 3																
Full SP/ML Integration - Training/Live Analysis																
Status Update 4																
SP/ML live analysis - long sessions																
Status Update 5																
EEG System Validation																
SP/ML System Validation																
Final Design Presentation																
Final System Demo																
Project Showcase																
Final Report																

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Execution & Validation Plan

Driver Drowsiness Detection Validation Plan:
ML/SP - Machine Learning/Signal Processing

Task	Specification	Result	Owner
ML/SP Integrated System Accuracy	> 90% success rate		Ali, Coady
ML/SP Integrated System Performance on MCU	For 30 second chunk of data, output drowsiness state in < 30 seconds		Ali, Coady
EEG Filters below 8 Hz	f>=8 Hz		Dakota
EEG Filters Above 30 Hz	f<=30 Hz		Dakota
Gain from Instrumentation Amplifier close to 100	G = 80+		Dakota
Final voltage readings have amplified from microvolts to volts	0.148<V<0.81172 But V<1 Input 15 Hz, 30uV		Dakota
Final voltage readings have amplified from microvolts to volts (Max and Min Readings)	Max Input: 10 Hz, 30uV Min Input: 1000 Hz, 20 uV		Dakota
System voltage input	6 V	Regulated to +-5V	All
Peak Power Consumption	2 W		All

Thanks for listening!