Team 61: Driver Drowsiness Detection
Bi-Weekly Update 2

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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

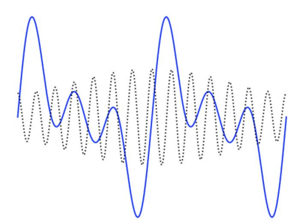
- Collect data
- Muse 2 EEG device

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

Project Timeline

January	February	March	January
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

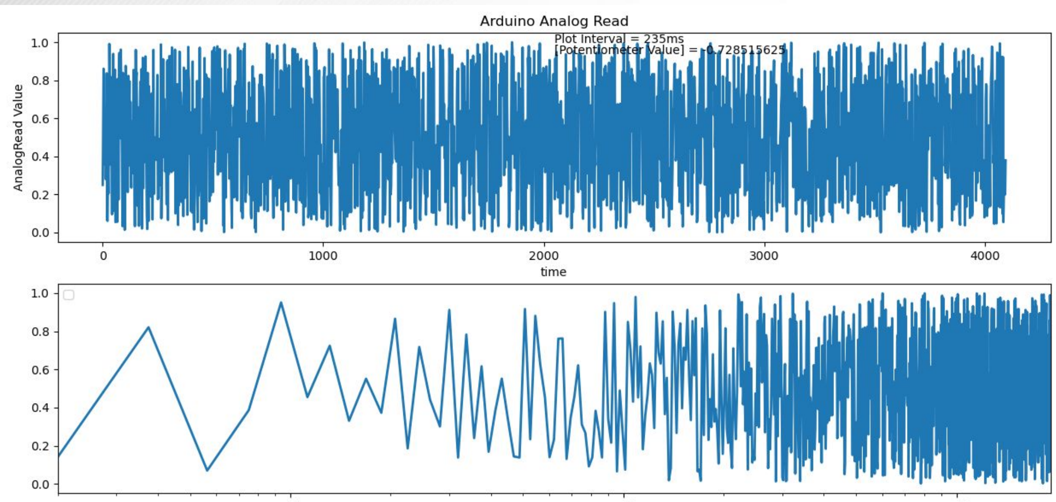
EEG Device

Dakota Mouton

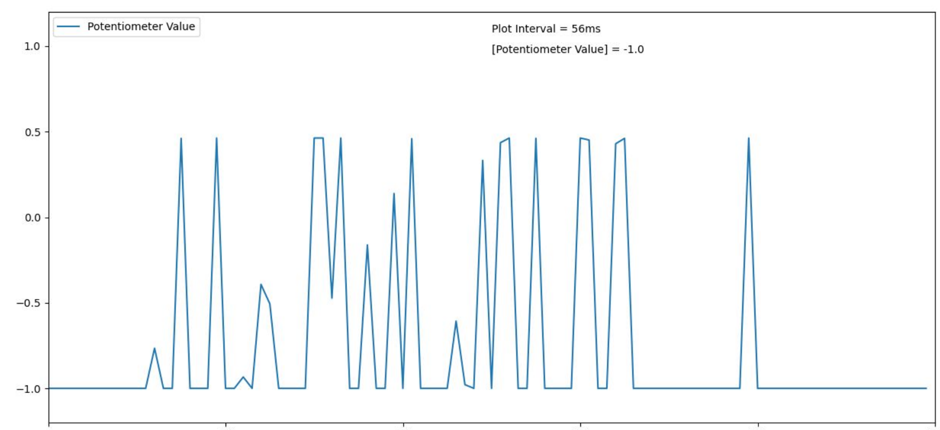
Accomplishments since 403 24 hrs of effort	Ongoing progress/problems and plans until the next presentation
• Reading live signals from electrodes through arduino board. • Switched to python for more robust live graphing of signal.	• Verify the live signals are actually as expected by analyzing signals 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



- Have FFT graph now showing with live waveform, but only shows one snippet of the signal and is not updating with the live signal.



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Signal Processing

Coady Lewis

Accomplishments since 403 12 hrs of effort	Ongoing progress/problems and plans until the next presentation
-Integrated live analysis with ML code to get real-time classification -Partially automated testing process for window size and overlap -Tested 20 different configurations on 4 hour dataset	-Will collect more data -Will rigorously test live output at the extremes of classification

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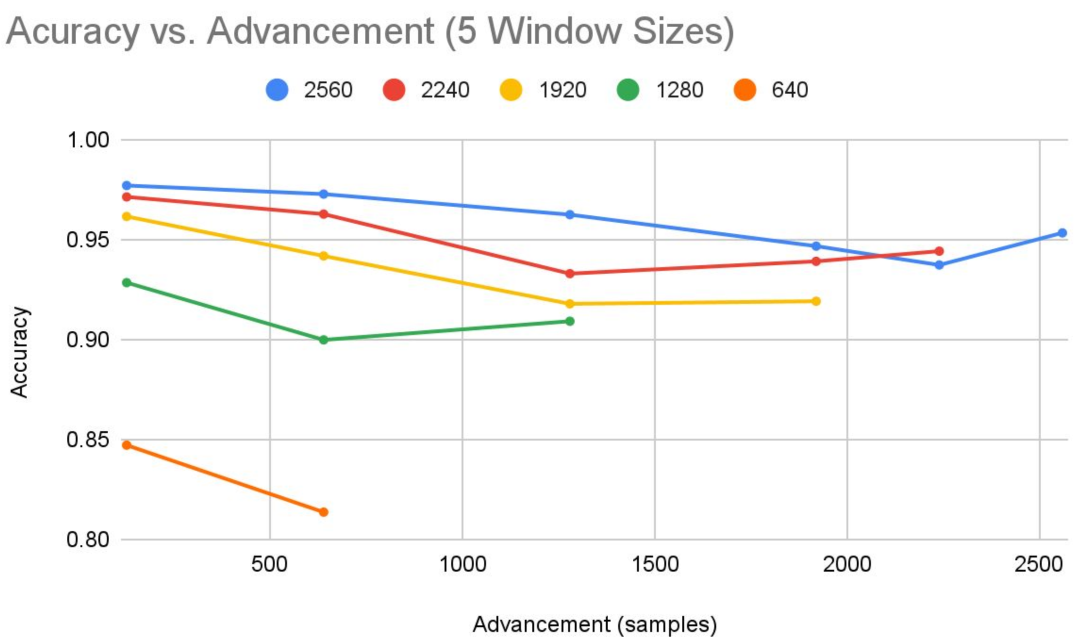
Signal Processing

Coady Lewis

-Consistent dip in performance as advancement decreases from its max, but performance then increased in all cases

-In all cases, the best results came with very low advancement parameters.

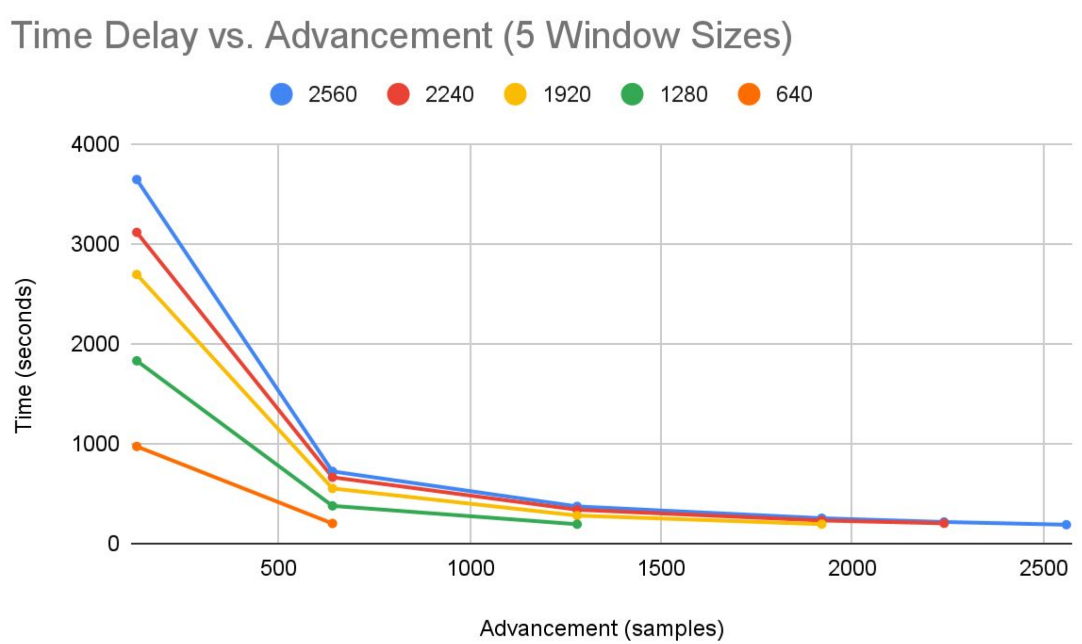


Signal Processing

Coady Lewis

-The total processing, training, and testing time drastically increases as advancement falls below 640 samples. It’s up to 1 hour per run so far.

-Lower advancement yields the best results, but there is a cost and a limit this method.



Machine Learning

Ali Imran

Accomplishments since 403 12 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 - Completed functions for loading trained model and using it to predict new values	- Collect more training data - Test current models with live analysis

Machine Learning

Ali Imran

	ML Model	
Signal Processor (W = 1280)	Kernel SVM	Neural Network
New: A = 1280 (0% overlap)	90.9	90.6
New: A = 640 (50% overlap)	90	89.1
New: A = 100 (92% overlap)	**94.1**	**91.8**
Original (403): A = 100	85	83.5

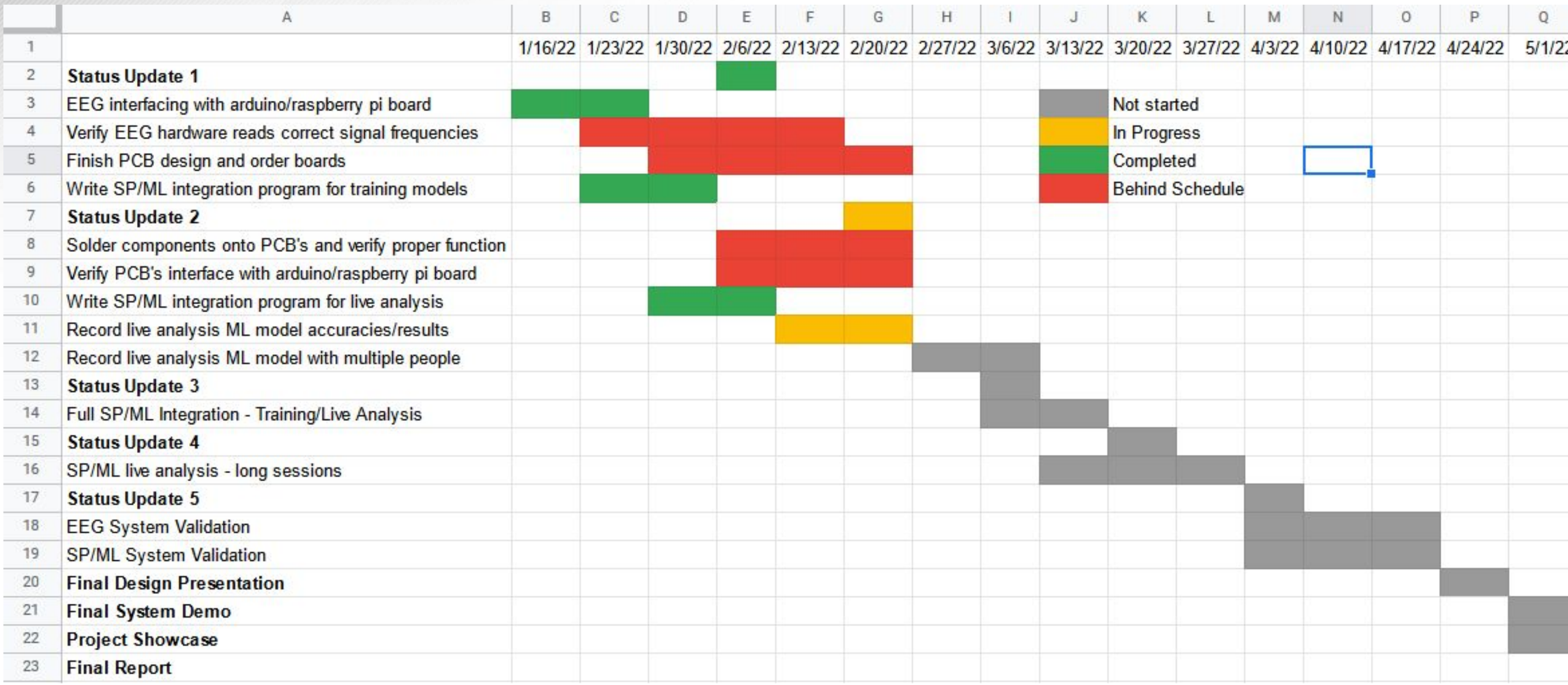
W = window size
A = advancement parameter (determines amount of overlap)

Live Analysis:
- Testing model on new person
- Longer sessions with approaching drowsiness

Parts Ordering Status

- EEG Device: PCB

Execution Timeline



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	Exceeded on existing datasets (up to 97%)	Ali, Coady
ML/SP Integrated System Performance	For 30 second chunk of data, output drowsiness state in < 30 seconds	Exceeded, smallest accurate classification interval at 2.5 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!