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ENGINEERING
TEXAS A&M UNIVERSITY

# Team 61: Driver Drowsiness Detection
# Bi-Weekly Update 4

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**TA: Max Lesser**

# 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

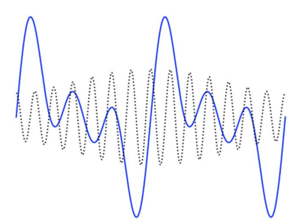
- Collect data
- Muse 2 EEG device

## 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 | April |
|---|---|---|---|
| SP/ML Light Integration | SP/ML Live Analysis Full Integration | Model Refinements | System Verifications |
| EEG/MCU Interfacing | Classification Testing | Transition State Classification Testing | Integration of SP/ML & EEG (stretch goal) |
| | EEG PCB Complete | Live spectrum analyzer for EEG | Final Presentations/Demo |

# Dakota Mouton

| Accomplishments since last update<br>18 hrs of effort | Ongoing progress/problems and plans until the next presentation |
| --- | --- |
| • PCB completely soldered and assembled.<br>• PCB is powering on and functioning. | • Finishing live spectrum analyzer program for EEG.<br>• Fixing software to take in I2C serial communication for data input.<br>• EEG validations. |

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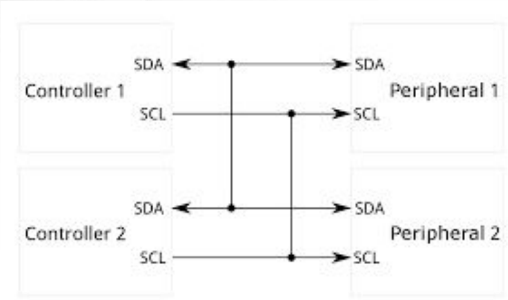
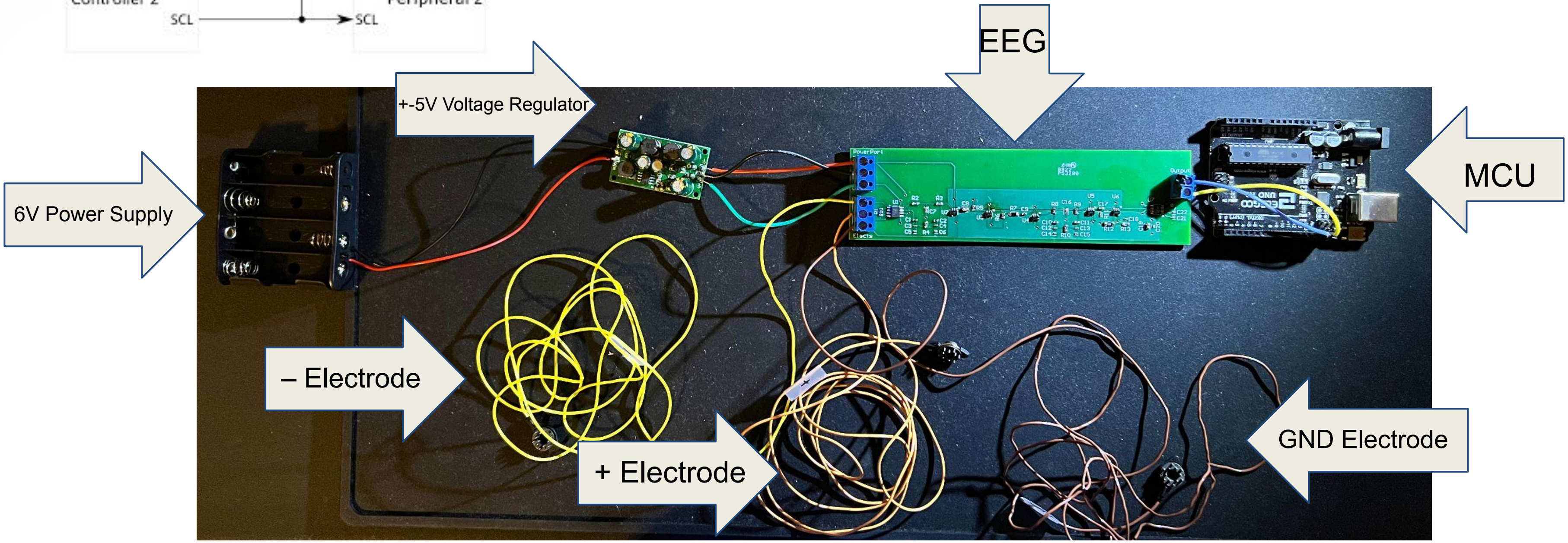
# Dakota Mouton

Inter-Integrated Circuit (I2C)




- Using I2C serial communication to interface the signal between the EEG device and the arduino board for live analysis.
- Continuing work on FFT live spectrum analyzer to see spikes for our target frequencies.
- PCB is turning on and sending signal to MCU.



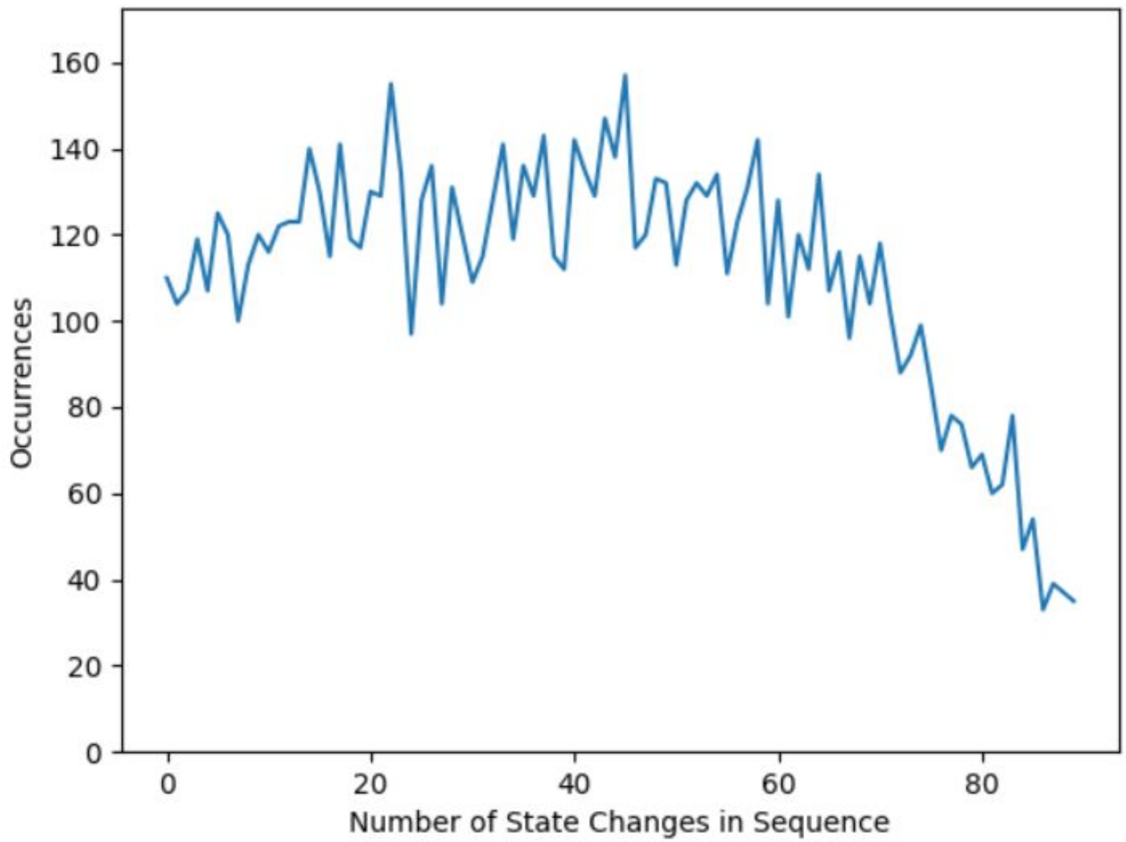
# Coady Lewis

| Accomplishments since last update<br>20 hrs of effort | Ongoing progress/problems and plans until the next presentation |
|---|---|
| -Researched LSTM layers and RNN’s to get more information into the model.<br>-Wrote and tested program to probabilistically generate augmented sequences for training an LSTM layer.<br>-Modified live analysis for modularity. | -Finish constructing LSTM layers.<br>-Finish formatting input sequences and labels.<br>-Test LSTM as both a trim for the KSVM output and as a standalone model. |

# Coady Lewis

-This is a test of the data augmentation script generating 10000 sequences.

-It's a histogram of the state changes in a single sequence.



# Ali Imran

| Accomplishments since last update<br>7 hrs of effort (26 total) | Ongoing progress/problems and plans until the next presentation |
|---|---|
| - Real-time live analysis graph implemented for Neural Network models<br>- Collected more “grey area” training data<br>- Tested models on new individual | - Collect more data, specifically around the “transition” region<br>- Test the model over a long session/multiple times in a day<br>- Implement RNN |

# Ali Imran

New **Drowsy** Data (15 min each)

```
Drowsy Fraction = 0.8869565217391304

Awake Fraction = 0.11304347826086956

Output Count = 115
```

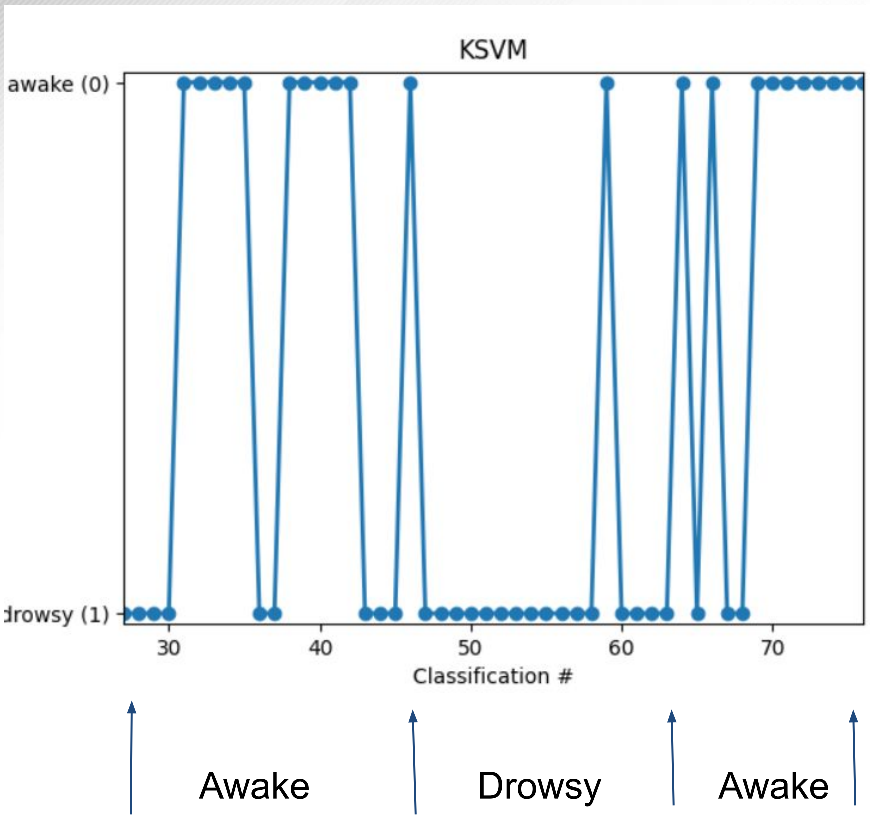
```
Drowsy Fraction = 0.7478260869565218

Awake Fraction = 0.25217391304347825

Output Count = 115
```

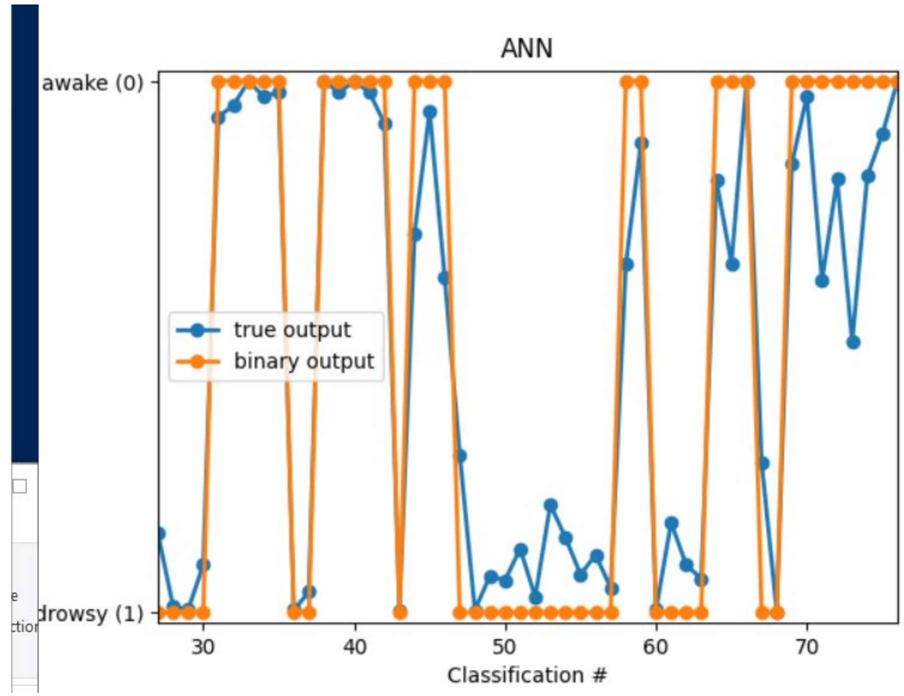
New **Near Awake** Data (15 min each)

```
Drowsy Fraction = 0.21367521367521367

Awake Fraction = 0.7863247863247863

Output Count = 117
```

```
Drowsy Fraction = 0.34782608695652173

Awake Fraction = 0.6521739130434783

Output Count = 115
```

# Ali Imran


KSVM
awake (0)
drowsy (1)
30
40
50
60
70
Classification #
Awake
Drowsy
Awake


ANN
awake (0)
drowsy (1)
true output
binary output
30
40
50
60
70
Classification #

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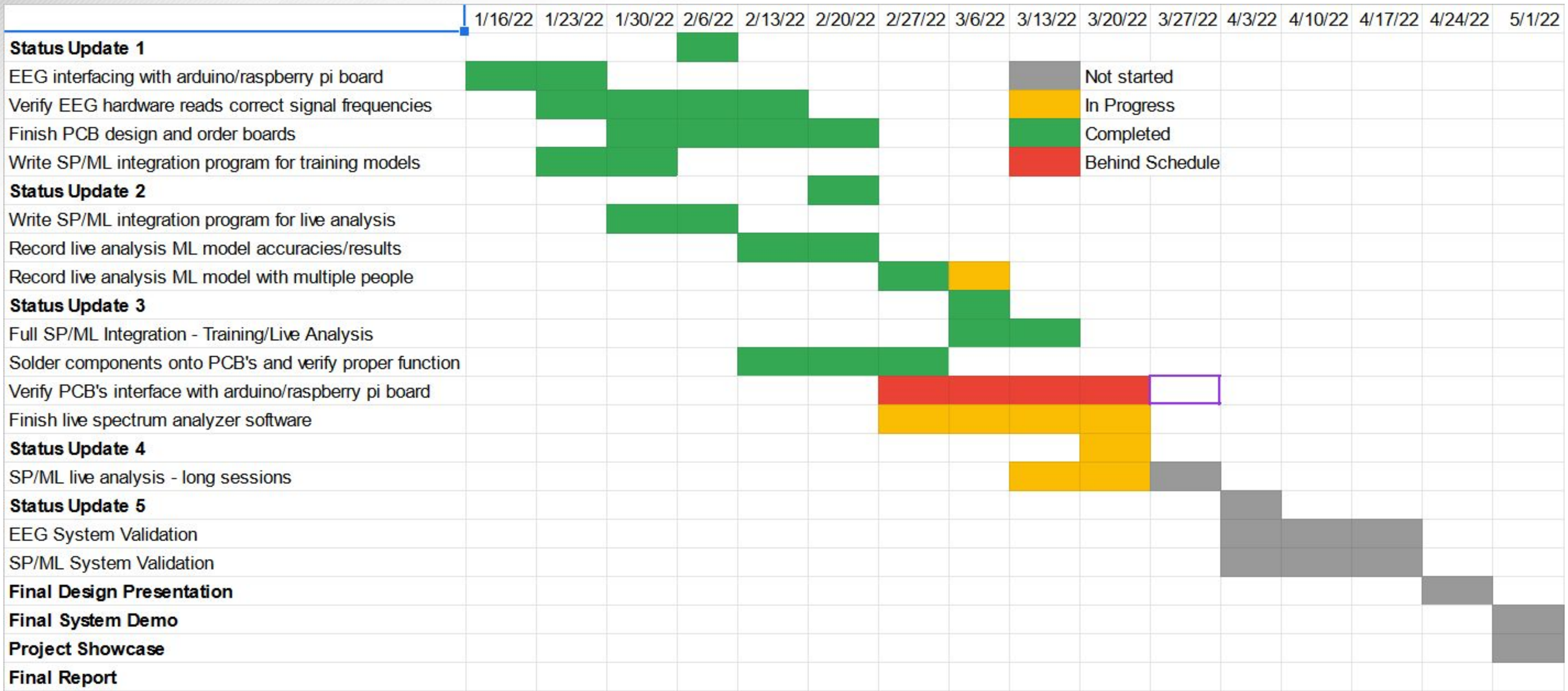
# Execution Timeline



# Execution & Validation Plan

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

| Test Name | Success Criteria | Methodology | Result | Owner |
|---|---|---|---|---|
| ML/SP Accuracy | > 90% success rate | Collect strongly labeled data (fully awake/drowsy) in real time of Coady/Ali and ensure classification accuracy is above 90% over 5-minute intervals | Exceeded on existing datasets (up to 97%) | Ali, Coady |
| ML/SP Performance | For 10 second chunk of data, output drowsiness state in < 10 seconds | Send a 10 second chunk of real-time data to ML/SP and ensure a classification is output within the next 10 seconds | Exceeded, smallest accurate classification interval at 2.5 seconds | Ali, Coady |
| ML/SP New Individual | For a new individual who hasn't had their data trained on the models, attain an accuracy of > 70% | Collect new individual's data in real-time and ensure classification accuracy is above 70% over 5-minute intervals | Currently very low accuracies | Ali, Coady |
| ML/SP Transition Detection | System is able to plot the point when someone goes from awake to drowsy | Collect data over a long session of Coady/Ali when going from an awake to drowsy state and plot the classification over time | Untested | Ali, Coady |
| EEG Filter Lower Limit | f=8-12 Hz | When we close our eyes for a short period of time there should be a spike on our FFT spectrum analyzer in the range of 8-12 Hz | Untested | Dakota |
| EEG Filter Upper Limit | f<=30 Hz | Our upper frequency range of fatigue is 30 Hz and want to test if power line interference (around 60 Hz) spikes which would cause noise and misreadings. | Untested | Dakota |
| Gain from Instrumentation Amplifier close to 100 | G = 80+ | Gain from Instrumentation amplifier close to 100 to properly amplify our signal voltages to a readable and manipulative level. | Untested | Dakota |
| Final voltage readings have amplified from microvolts to volts | 0.148<V<0.81172<br>But V<1<br>Input 15 Hz, 30uV | Final voltage readings have amplified from microvolts to volts | Untested | Dakota |
| Amplified Final Voltage Readings (Min/Max) | Max Input: 10 Hz, 30uV<br>Min Input: 1000 Hz, 20 uV | Final voltage readings have amplified from microvolts to volts (Max and Min Readings) | Untested | Dakota |
| System voltage input | 6 V | Verifying components receive proper operating voltages to function correctly. | Regulated to +-5V | All |
| Peak Power Consumption | 2 W | To be used to determine how long the device can last running off AA batteries and efficiency of the device. | Untested | All |

# Thanks for listening!
# Questions?