NeuroPaint

Manjari Anant, Morgan Graham, Usman Khan

Inspiration

Jon, who had an incomplete spinal cord injury for many years, is grateful for his ability to play the guitar after regaining motor function.

Goals

1. Give individuals with loss of motor function a platform for creative expression
2. Create a multi-faceted experience where loss of motor function has no impact on the ability to create
3. Align with the mission of CNT through significantly improving the quality of life for movement-impaired individuals

Project Overview

Muse Headset

EMG (blink) signals

EEG signals

Blink Signal Analysis

EEG Signal Analysis

Timing and number of blinks

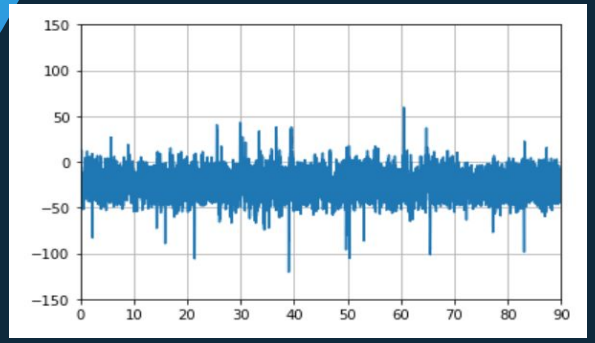
Brain Wave Power Bands

Neural Network

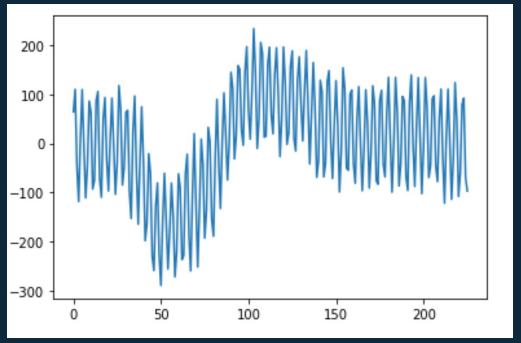
Image

User Interface

Blinking



Muse data EEG/EMG signal



Blinking filter

Identify occurences of filter in Muse data

Number and timing of blinks

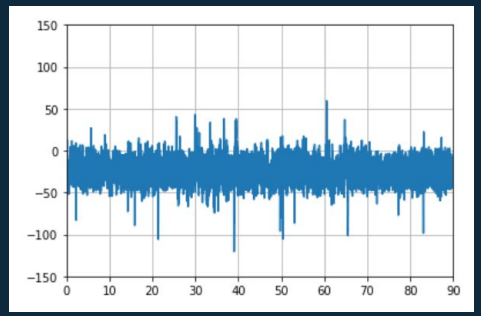
Neural Network

EEG Brain Wave Analysis

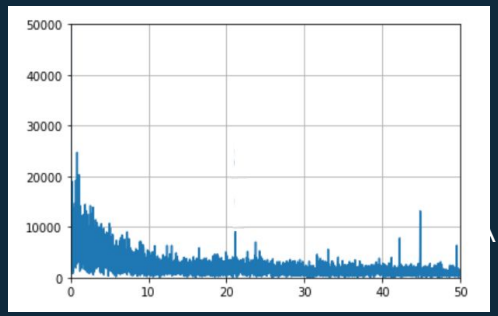
Brain Waves of Interest:

- Alpha Waves (8 - 12 Hz) - relaxation and daydreaming
- Beta Waves (12 - 30 Hz) - normal state of consciousness/alertness

Time-Domain Signal



Frequency-Domain Signal



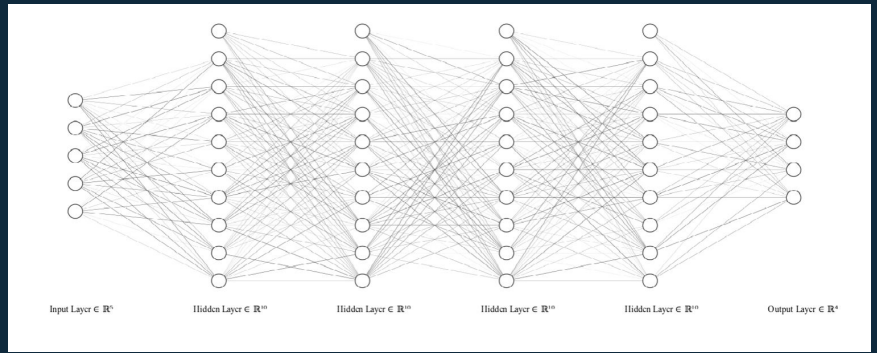
Extract power signal data

Alpha to Beta power signal ratio

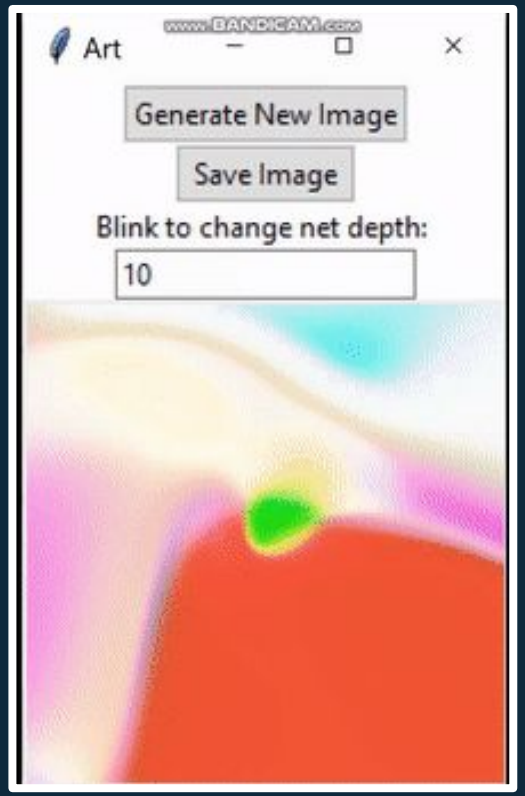
Neural Network

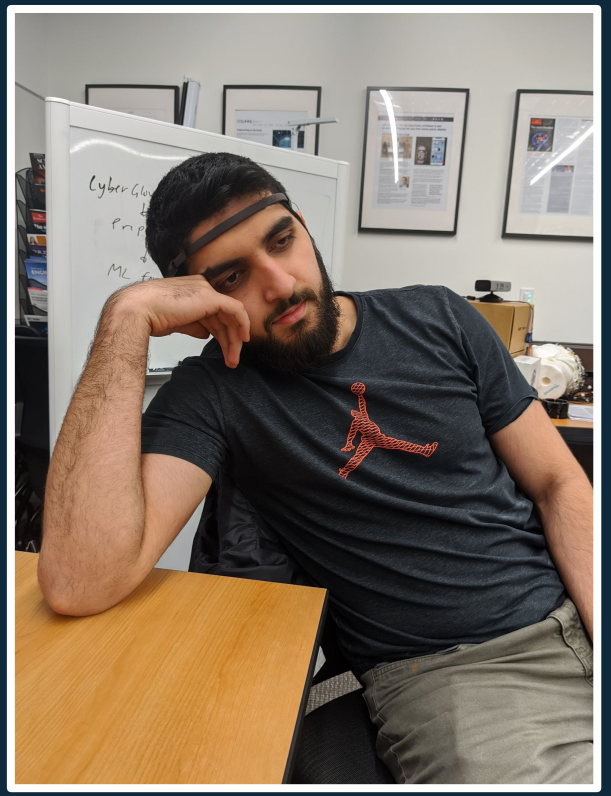
Neural Network

- Neural Network architecture is used to navigate a wide array of possible images with few inputs while maintaining smoothness
- Parameters tweaked by input from EEG analysis:
  - Network size/dimensions (blinks)
  - Color mode (brain waves)
  - (Future) activation function, initial weight distribution



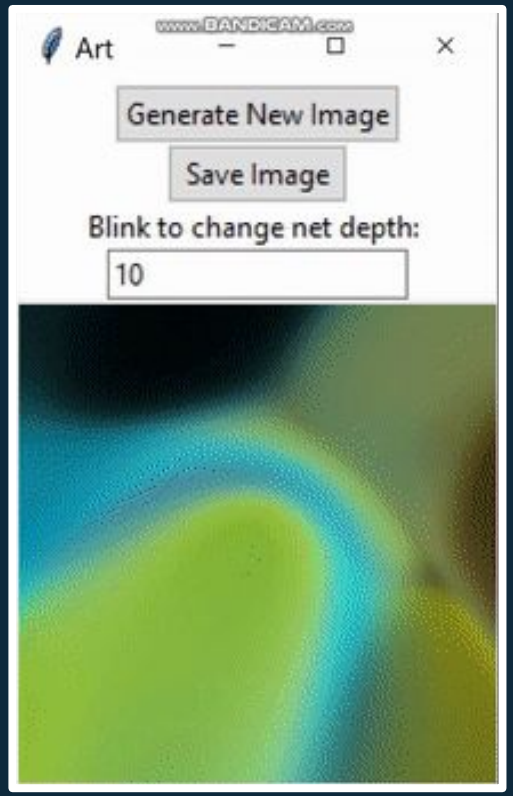
Restful State

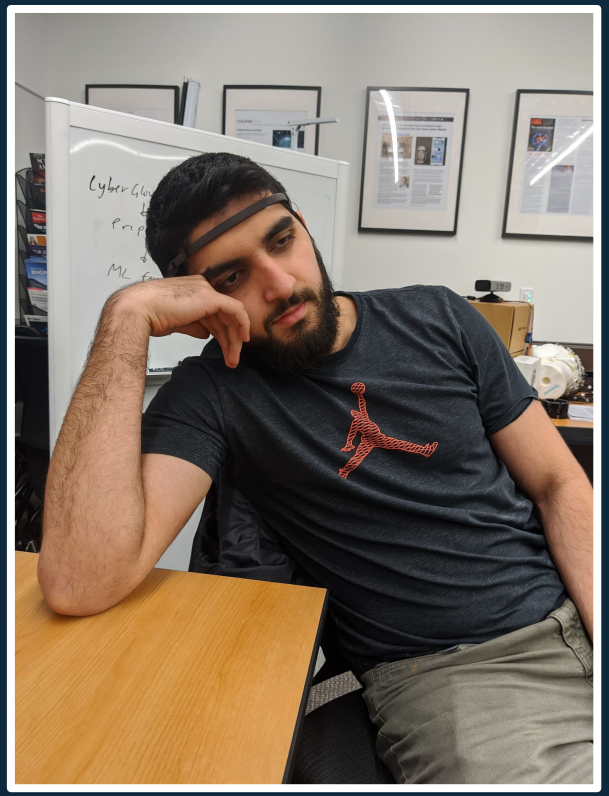




Post CNT hackathon

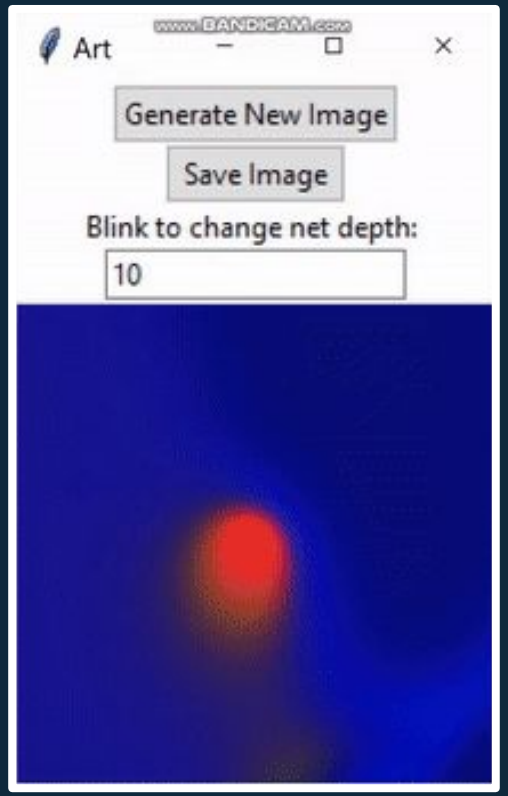
Restful State

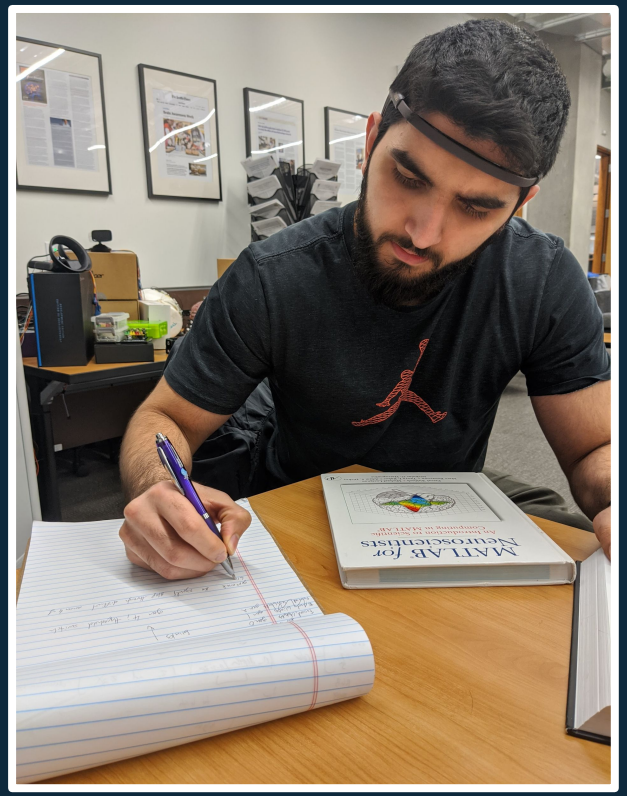




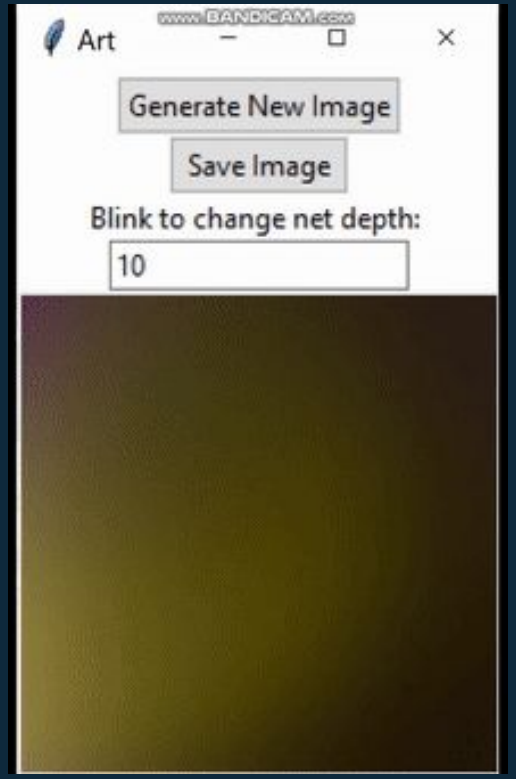
Quitting engineering to become an artist

Alert State


Art
www.BANDICAM.com
Generate New Image
Save Image
Blink to change net depth:
10


MATLAB for Neuroscientists

Alert State


www.BANDICAM.com
Art
Generate New Image
Save Image
Blink to change net depth:
10

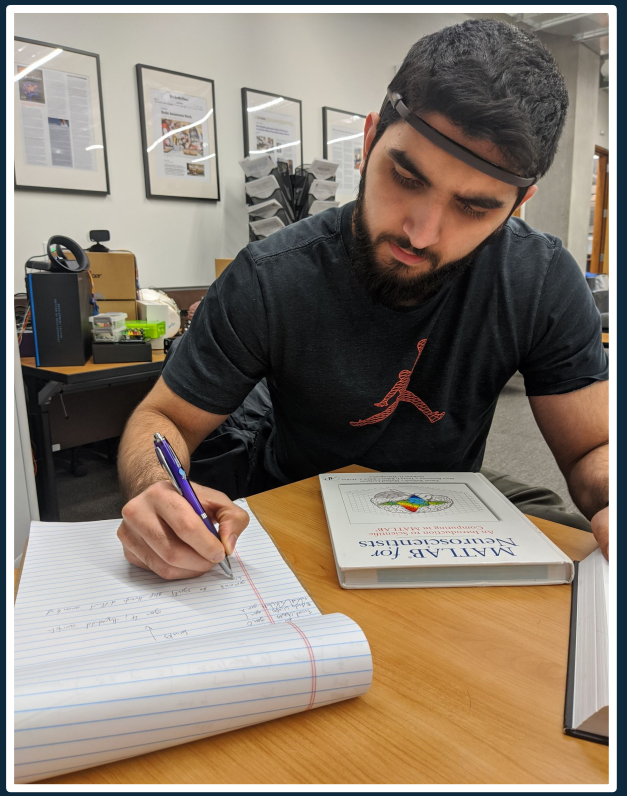

MATLAB for Neuroscientists

Image Evolution

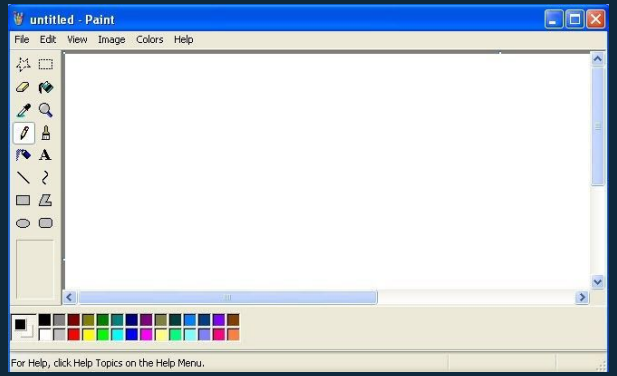
Ethical Considerations

- Potential misrepresentation of brain state
- Sharing of brain state indicators
- Ownership of algorithmically generated art

Extensions

- Further develop UI
- Eye tracking
- Hololens integration
- EMG signal integration

Microsoft HoloLens



References

- https://www.cnn.com/style/article/ai-art-who-should-get-credit-conversation/index.html
- https://www.mind-your-reality.com/brain_waves.html
- https://choosemuse.com/blog/a-deep-dive-into-brainwaves-brainwave-frequencies-explained-2/
- https://www.sciencedirect.com/science/article/pii/S0092867416314490
- https://www.researchgate.net/figure/Fast-fourier-transform-FFT-of-EEG-channels-and-downward-acceleration-showing_fig1_290507586
- https://www.researchgate.net/publication/312422191_Human_Emotion_Detection_via_Brain_Waves_Study_by_Using_Electroencephalogram_EEG
- https://www.sciencedirect.com/science/article/pii/S0149763411000832#bib0030

Acknowledgements

We would like to acknowledge Courtnie Paschall and the members of the CNT for their guidance and support during our project.

Thank you to the CNT for giving us this opportunity!

Thank you!