CS495 | PhysioGaming Meeting Notes

09/09/2025

PhysioGaming Initial Meeting
This is a high level overview of the hardware and existing repo

Game - FlyWorld

- Basic. Move around, fly, collide w/ parts,

Hardware - EMG Sensors

- Detect electrical signals from muscles tightening,
- Connects to laptop via Bluetooth,

Important components

ML/AI

- Signal processing,
- Modeling,

Unity

- Interaction design,
- Look & feel,
- Message passing,

First steps

- Connect jetpack of FlyWorld to signal processing -- velocity scales with signals,
- Take existing games and try to map to muscle energy,
- Connect EMG/ get feedback/ playtest,
- Look into 10 hour Unity guide (not whole thing) that was sent in Dr. C's Discord,
- Look into EMG to JS repo as well as JS to Unity repo,
- To start, connect EMG to jetpack in a binary way (jetpack turns on and off with input from EMG),
- Look into ONNX runtime / look into tutorials

09/11/2025

Sam Daly

What has been done:

- Got sensor output into Unity

What will be done:

- Ask Dr. Crawford for another battery

What has been hard:

- Finding a definitive entry point for the project

Noah Morgans

What has been done:

- Getting acquainted with Unity/Tensorflow/Pytorch/ONNX

What will be done:

- Continue acquaintance
- Look into ML Models

What has been hard:

- Time management
- Deciding where to start

John Byrd

What has been done:

- Getting immersed with all documentation/Github/Unity

What will be done:

- Further depth with documentation
- Research ML models

What has been hard:

- Planning a clear agenda for the project

Josh Hipps

What has been done:

- Watched Tensorflow tutorial video
- Managed Notion workspace

What will be done:

- Do research on ML options for project specifications
- Determine useful Python libraries

What has been hard:

- Defining a clear agenda
- Finding a starting point for tech

Cade Dees

What has been done:

- Started Unity tutorial video

What will be done:

- Finish first quarter of Unity tutorial video

What has been hard:

- Learning Unity from scratch

09/16/2025

Sam Daly

What has been done:

- Researched Pytorch and Tensorflow

What will be done:

- Looking into data properties

What has been hard:

- Determining details about machine-learned inferencing

Noah Morgans

What has been done:

- Researched Pytorch and Tensorflow

What will be done:

- Finish studying applicable software
- Plan and organize machine learning structure

What has been hard:

- Time management with other classes and activities

John Byrd

What has been done:

- Looking over Dr. Crawford's HTML to Unity repo

What will be done:

- Finding out how to best use raw EMG data
- Determine feature engineering and most efficient model

What has been hard:

- Conceptualizing the entire flow of the project

Josh Hipps

What has been done:

- Finalized sprint 1 document
- Experimented with Pytorch libraries

What will be done:

- Recording properties of EMG signals
- Determine the best signal processing functions and parameters

What has been hard:

- Nothing terrible, difficulty with time management

Cade Dees

What has been done:

- Watched more of the Unity tutorial
- Began Unity environment setup

What will be done:

- Finish the Unity tutorial
- Connect EMG to laptop

What has been hard:

- Connecting the EMG to a local machine

09/18/2025

Sam Daly
- What's been done:
  - Unity Testing
- What will be done:
  - Exploration of Biosignal Data Format
- What's been hard:
  - Interpreting Brainflow Documentation

John Byrd (Absent)

Cade Dees
- What's been done:
  - Reviewed Unity video
- What will be done:
  - Finish the recommended portion of Unity tutorial
  - Connect EMG to laptop
- What's been hard:
  - Computer resources have been unavailable due to digital forensics work

Josh Hipps
- What's been done:
  - Decided on 1-D Conventional neural network
- What will be done:
  - Which one though?
- What's been hard:
  - Choosing a model

Noah Morgans
- What's been done:
  - Strengthened AI learning methods knowledge
- What will be done:
  - Look more into building machine learning coding
- What's been hard:
  - Very busy Tuesday night through Thursday meeting time, can't do much

Discussion with Dr. Crawford
- Implement transformers.js for signal processing
  - Audio processing repos
  - Hosted on hugging face?
- Use ai-machine-learning channel in HTIL discord
- Repos: https://github.com/facebookresearch/generic-neuromotor-interface
  - GNI/GNI/networks.py
- Generic EMG decoding discrete gestures, 3 class or 2 class
- Architecture made from Spectrogram / Imagenet / Mobilenet
- Establishing our clone Flyworld repository, including all Flyworld scripts
- Classification done by state machine. State determined by rolling average of the potential difference - sustained value creates action

09/20/2025

Sam Daly

What has been done:

- Getting EMG data to output on local machine

What will be done:

- Get the data the EMG output to be more readable

What has been hard:

- Interpreting the raw data of EMG

Noah Morgans

What has been done:

- Worked with Unity to JavaScript connection

What will be done:

- Record EMG data properties

What has been hard:

- Allocating time to record data properties

John Byrd

What has been done:

- Researching signal processing & machine learning
- Analyzing repos from Dr. Crawford

What will be done:

- Create definite plan for thresholding different gestures
- Implementing Squeeze to Shift

What has been hard:

- Visualizing the big picture

Josh Hipps

What has been done:

- Experimentation with Pytorch library and functions

What will be done:

- Compile list of necessary signal properties

What has been hard:

- Planning how to negate noise

Cade Dees

What has been done:

- Worked to set up Unity and load FlyWorld package

What will be done:

- Editing the FlyWorld environment

What has been hard:

- Unity

09/23/2025

Sam Daly

- What's been done:
  - Figured out data format coming out of the board
- What will be done:
  - Start simple and try to map the jetpack "shift" button to some signal from the muscles
- What's been hard:
  - Finding patterns in the data that will be workable

John Byrd

- What's been done:
  - Researching the sensor data properties
- What will be done:
  - Will meet with Josh to discuss what can be done with data & the next steps
- What's been hard:
  - Knowing how to best move from input to the model

Cade Dees

- What's been done:
  - Trying to setup Unity environment to test on Flyworld
- What will be done:
  - Reverse engineer Flyworld and modify inputs/figure out how to map to shift
- What's been hard:
  - Unfamiliarity with Unity and Unity hub

Josh Hipps **(Absent)**

Noah Morgans

- What's been done:
  - Did research on Brainflow to help figure out how data is structured and collected
- What will be done:
  - Start to develop a very elementary ML framework to process our data
- What's been hard:
  - Hard to really learn when we only have one device

09/25/2025

Pivot to threshold for binary signal interpretation

- Rolling average for last 50 samples
    - If average > 200 mv potential difference, fist is clenched
    - Less is generalized to relaxed hand
- Noah build rolling average
- Cade build Unity testbed
- Combine in Unity
    - Use Javascript to Unity pipeline?
- Everyone review the pipeline and imagine a method to implement our threshold

Possible implementation strategy:

- Pass data to Unity and use C# to threshold
- Pass inference to Unity and use C# to activate flying
    - Inference on separate API and use sockets to communicate
    - Use Python for reading from board, use OpenBCI libraries

09/30/2025

- Sam established a rudimentary method to implement EMG signals as action within Unity
- Noah's thresholding and rolling average working and modifiable

Thresholding

- Using thresholding a rolling average to signal true/false for a fist squeeze
- Using a Python file w/ BCI library
    - Implement the thresholding as Java
- In a generic empty sandbox
    - Implement the method with Flyworld
        - Someone need's to get Flyworld running
- Big problem: Not connected to Crawford's Unity pipeline in any fashion
    - Javascript to Unity pipeline ? Where can thresholding be fit in
- Fix improper movement
    - Currently moves on 'forward axis' in relation to the character position
    - Need it to accelerate on true y-axis, regardless of position

Game Ideas:

- Need to meet with Crawford and ask if we can pivot game idea
- Flyworld base:
    - WASD movement, shift to fly, mouse to look
    - Could add objectives within Flyworld sandbox
        - Parkour, time trials, coin collection, flying routes
- Cannot use mouse with EMG activation methods
    - Drop a dimension, work 2D or 1D ideas
    - Temple run, Jetpack joyride, Flappy bird, Subway surfers

10/02/2025

Demo with Crawford in HTIL
- First time ever EMG -> Unity
- Python implementation is okay for first steps, but it **needs** to work on Flyworld
    - Not our own project, collaborative effort
    - Work with Michael in HTIL
    - Javascript to Unity pipeline is incomplete but rudimentary method of passing strings
        - Passing data into Unity? Or passing inference into Unity
    - Expand the Flyworld environment to set up for playtesting
- Challenge: Implement machine-learned inferencing
    - Our idea: Some model of 1-D CNN
    - Expand gesture recognition
        - Record properties of different gestures

Making presentation: Meet on Sunday
- Introduction / Group overview
- Demo options
    - Video of testbed
        - OBS, camera of arm in corner
        - Simple flying
    - Do it live!
        - Setup before presentation
        - Make testbed look good
            - Testbed feels bad but should work for simple vertical movement demo

10/07/25

Sprint 1 Deliverables due

Presentation:

1. Introduction & Group Overview: Cade
2. Goals: John
3. Achievements: Josh
4. Sponsor Feedback: Josh
5. Project backlog: Noah
6. Reflection: Noah
7. Contributions intro: Sam
8. Demo: Sam

Notes: Josh

Sprint 1 Presentations
Feedback on Google Drive

10/09/25
Sprint 1 Presentations
Feedback on Google Drive