

Project Proposal

Basic Info

Title: MotionPI System Visualization

Course: CS-6630 (Fall 2025)

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GitHub repository: <https://github.com/foadnamjoo/Vis-for-ENMO>

Background

We, as a research group, developed from scratch a system for monitoring patients' physical health, their mood, and the environment. Wearable and mobile-health studies collect large streams of sensor data (accelerometry, battery, storage, and app events). However, researchers and engineers often lack a unified system-level visualization to understand how these components interact in real time. Especially when data sources are different and the data is big.

Motivation

Beyond data analysis, this project emphasizes my system design and visualization for multiple data sources helping other researcher from Huntsman Cancer Institute understand participant health patterns.

Project Objectives

1. Explain activity bouts (ENMO threshold detection).
2. Relate events to system behavior.
3. Diagnose reliability issues.
4. Support adjusting the parameter. (final product will be interactive plots)
5. Demonstrate system design via a modular dashboard.

Data

All data is gathered from my designed database (CHPC cloud MongoDB)

Primary Data: Cloud ENMO CSV, Device ENMO CSV.

Context Data: App Logs CSV, Battery/Storage CSV.

Privacy

Participant IDs and MACs only; demo CSVs will be included. All identification of participants, like location, will be removed.

Data Processing

Normalize timestamps; canonicalize MAC addresses. I use UNIX timestamps for different data types, ensuring synchronization.

Resample ENMO, compute PA-EMA, deduplicate events. ENMO data (showing participant activity) is too heavy for visualization. I resample for 4 seconds or maybe 1 minute.

Align battery/storage with ENMO time span.

Implementation

Preprocessing in **Python**, browser-side pipeline in **JavaScript**, and showing plots using **HTML** format to Google Chrome.

Visualization Design

Unified overlay with ENMO, moving average, PA-EMA (activity-triggered surveys), event markers, battery/storage, day/night shading, showing missing values visually, and user-friendly, interactive integrated controls.

Must-Have Features

ENMO time series with moving average and threshold.

PA-EMA visualization. Like a feature that the user can hide/show by clicking on the plot legend.

Event markers, battery, and storage levels with different colors and styles.

Interactive pan/zoom, presets, range slider, PNG export, and easy time windows search.

Optional Features

I may do these extra features if I find enough time: anomaly detection and the drag-and-drop CSV loader.

Project Schedule

Week 1: Repo setup, CSV loader.

Week 2: ENMO rendering + moving average.

Week 3: PA-EMA derivation and visualization.

Week 4: Events + battery/storage layers.

Week 5: Code optimizations.

Week 6: Visualization optimization.

Week 7: Optional features.

Week 8: Final implementation polish, usability.

Week 9: Screencast draft, README.

Week 10: Milestone release + peer feedback.

Week 11–Finals: Final polish, video, deployment.

Evaluation Plan

Task checks: PA-EMA trigger identified correctly or not, reliability diagnosis, cloud vs. device ENMO comparison.

Qualitative design principle checks.

Performance: smooth and scales up to 100k points.