

Project title: Cognito – a “WHOOOP” for the Brain

- **Project concept (2-3 sentences):** A BCI built into a normal-looking cap that continuously tracks cognitive states like focus, mental load, stress, and fatigue in real time. By learning when you're naturally most alert and when you tend to be more mentally fatigued, it would act as an intelligent study buddy that visualizes your brain performance, nudges you to take breaks, and recommends optimal times for work. Over time, it could build a personalized cognitive profile and suggest schedules and work blocks that align with user's actual brain state.
- **What is the core idea of the project:** To turn real-time EEG signals from a discreet BCI hat into an adaptive “brain coach” that learns your focus and fatigue patterns and then optimizes your study/work schedule around when your brain actually performs best.

Goal/Purpose:

- **What can the user do:** can wear cap during study, work, or training sessions and see their brain state reflected in real time as simple, intuitive feedback (e.g., flow state, high mental load, stress, fatigue). They can start and stop “focus sessions,” track how long they spend in each state, and review summaries that show when they were most alert, when they began to burn out, and how their brain responded to different tasks.
- **How do they interact with technology:** user wears cap and uses a companion app, where they can start/stop sessions, see a live “brain state” gauge, and review recommendations from LLM type chatbot - EEG is streamed passively in the background while they continue working normally with their phone or another tool
- **What is the intended outcome of the product:** to “decode your brain” by translating raw EEG into simple insights about focus, fatigue, mental load, (and maybe emotional tone too), so user can structure their day around when their mind actually works best.
- **Could also add feature where over time, cap also acts like a “BeReal for emotions”** capturing a daily emotional snapshot and helping you notice patterns in how you feel and perform across days and weeks.
- **Finally, app can serve as interface for users to play other BCI games e.g., tug of war, using Cognito,**

Technology overview:

- **What hardware will be used:** A custom cap with embedded dry EEG electrodes and a small EEG amplifier, an onboard IMU (accelerometer/gyroscope) for motion tracking, plus a Bluetooth- or WiFi-enabled module streaming data to a smartphone running the app.
- **What signals will be measured:** Primarily EEG signals from frontal (and possibly parietal/occipital) regions to capture bands linked to focus, cognitive load, fatigue, and emotional arousal, along with IMU data (head motion) to correct for movement artifacts. Could also integrate heart rate/HRV or other wearable data to better estimate stress and recovery.
- **How will EEG data be read into the app (describe how brain activity becomes an action):** Will it use

- Threshold-based control (if focus > X → action)
 - Yes – e.g., if focus stays above a threshold, the app rewards a “flow streak”; if fatigue or stress exceed a threshold, it prompts a break or logs a “red zone.”
- Continuous control (higher concentration → faster action)
 - Yes – engagement and load indices continuously modulate the height/colour of a focus bar and other UI elements, so small changes in state become visible in real time.
- Trigger-based control (blink=action)
 - Possibly for simple interactions like quadruple-blink to mark a moment or to tag an event.
- Other mappings
 - Daily “emotion check-ins” where the app pairs an automatically detected arousal/valence pattern with a quick self-report, creating a daily emotional snapshot and longer-term mood/cognition timeline.

Development Plan:

- Describe the user interface / screen layout (what the paper will see in the main screen):
 - The main screen could be something similar to WHOOP: at the top, a large “Brain Recovery” ring shows your current readiness (e.g., Low / Moderate / High) [could change this to something more relevant], and beneath it a “Cognitive Strain” bar tracks how hard your brain has been working so far today. A simple state strip (color-coded timeline) runs across the middle, showing when you were in flow, high load, stressed, or fatigued. Below that, tiles let you jump into different modes: “Focus Session,” “Schedule Insights,” and “EEG Games.” In Focus Session, you see a live focus gauge that moves continuously with your engagement; in EEG Games, you can play games like “concentration tug-of-war” or a “flow race” where sustained calm focus makes a character move faster (could set personal best times for 1000m run etc.). A bottom nav bar provides quick access to Home, History (past days of brain recovery/strain), and Settings.
- Logical workflow (explain how the project will be built in steps):
 - Get the EEG hat + IMU talking to the app and visualize raw signals in real time.
 - Add filtering, motion-artifact handling, and simple EEG features ($\theta/\alpha/\beta$ band power).
 - Build a short calibration flow and train a model to label windows as flow, high load, fatigue, or stress
 - Implement a WHOOP-style dashboard
 - Create simple concentration games and aggregate data over days to suggest optimal work times and rest windows

Total Estimated Budget: EEG hat that we have, IMU, amplifier board, wireless module, misc electronics, and basic app dev