Project title: EEG Balatro (Card game -)

Project concept *(2-3 sentences)*:

- This project seeks to upgrade the 2024 Game of the Year, *Balatro*, to be controlled using an EEG headset. With the game's simple controls and highly strategic nature, *Balatro* lends itself well to be controlled via EEG using a method called SSVEP (Steady State Visually Evoked Potential) to detect brain activity. By introducing a hands-free way to play, this project seeks to not only expand accessibility to one of the highest acclaimed games in the last year but also attracts established *Balatro* fans to reimagine their experience in a revolutionary manner.

Goal/Purpose:

- What can the player do:
  - The player can make strategy-based decisions by focusing on various parts of the screen. This allows them to customize and build their deck to reach higher scores.
- How do they interact with technology:
  - They interact via SSVEP, which entails focusing on the part of the screen that is flickering at the frequency that corresponds to the decision they want to make. For instance, part of the screen will flicker at frequency A that corresponds to yes while the opposite side of the screen flickers at frequency B corresponding to no, and whatever side of the screen that the player focuses on can be interpreted through the EEG headset, thus reading the player's decision.
- What is the intended outcome of the game:
  - The intended outcome is for new players who may experience a disability to be able to play our spinoff of *Balatro* and for returning players to enjoy playing a game they like in a way they never have.

Technology overview:

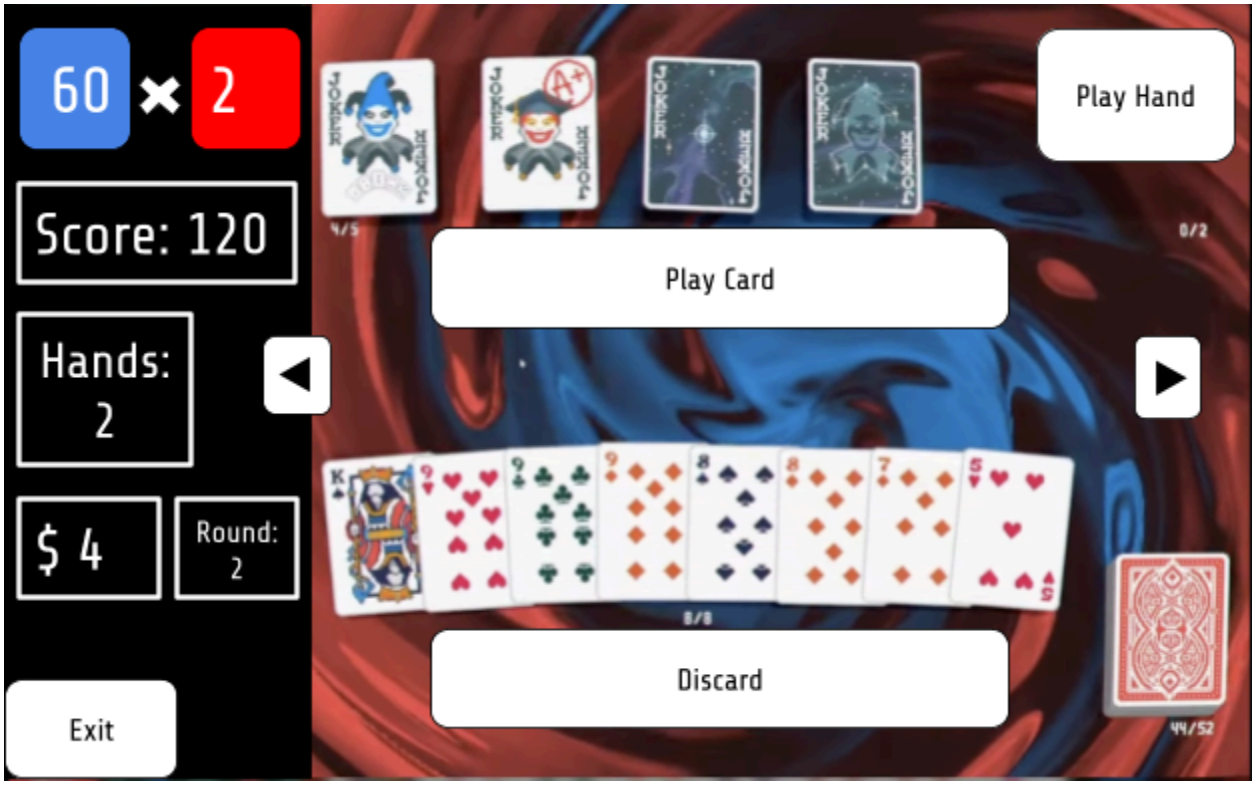
- ➔ What hardware will be used: g.tec EEG headset
- ➔ What signals will be measured: Occipital Electrodes (e.g. Oz, O1/O2)
- ➔ How will EEG data be read into the app (describe how brain activity becomes an action):
  - ◆ Threshold-based control with frequency detection: When the player focuses on a flickering element (left side at specific Hz = "discard", right side at specific Hz = "keep card"), the EEG measures increased activity at that frequency in the occipital lobe. Once the signal crosses the threshold, it can trigger the corresponding action. (Probably easier & more convenient for discrete actions)
  - ◆ Continuous control for intensity mapping: longer/harder they focus, the more confident the system interprets their choice
    - e.g. 0.5 seconds of focus = 50% confidence (maybe card gets highlighted but not discarded yet) & 1 second of focus = 100% confidence (card gets discarded)
  - ◆ The data the headset collects will be input into a custom-trained machine learning model to quickly interpret the decisions
- ➔ Software:

- React Native, Flutter, or some other mobile development framework for building the app
- LSL (Lab Streaming Layer) to collect, record, synchronize, and stream EEG data from the headset to the mobile device

Development Plan:

- Describe the user interface / screen layout (what the player will see in the main screen):
  - Main screen can display:
    - Central game board showing the current hand/cards
    - Left and right "decision zones" with distinct visual flicker frequencies
    - Visual feedback indicator showing which zone the EEG is currently detecting focus on
    - Score, round counter, and game status at top

UI Mockup



- Logical workflow (explain how the project will be built in steps):
  - **Phase 1 - EEG Integration**
    - EEG signal acquisition and preprocessing pipeline
    - Calibration module to establish player-specific baselines
    - Testing frequency detection accuracy with simple binary choice interface
  - **Phase 2 - Game Components**
    - Recreate simplified Balatro mechanics (card dealing, hand evaluation, scoring, shop)
    - Map game decisions to binary/multiple SSVEP choices

    - Implement flickering decision zones with precise frequency control
- **Phase 3 - Iterating/Improving**
    - Add progressive difficulty (longer rounds, more complex decisions)
    - Balance game pacing for EEG control method
    - Have different individuals serve as players to collect a wider range of EEG data that can train a machine-learning model to quickly interpret decisions
    - A well trained ML model is critical for the game to work across players
- **Phase 4 - Testing + Additional Features**
    - Test it on users
    - Can iterate on the signal threshold
    - Add game complexity to increase strategy
    - Can consider tutorial mode??

Total Estimated Budget:
Since we already have the EEG headsets, most if not all of the costs (apart from headset repairs) will lie in publicly launching the app (servers, app store submission fees, etc.) Despite this, the total cost shouldn't exceed $100.