Multi-modal Gaze Tracking for BCI Navigation

In this project, students will design and implement an eye-gaze tracking system. The system will focus on using gaze data to provide spatial context, reducing the search space for neural decoding and enabling more natural interaction in mobility and smart-environment control.

Key Objectives

- **Gaze Data Acquisition**: Interface with an eye-tracking system to acquire real-time gaze coordinates and pupil metrics.
- **Spatial ROI Mapping**: Develop algorithms to map gaze coordinates to specific "Regions of Interest" (ROIs) on the interface, such as flickering SSVEP icons or keyboard characters.
- **Dwell-Time and Fixation Analysis**: Implement robust fixation detection to differentiate between natural scanning and intentional selection.
- **Adaptive Gaze Correction**: Implement a calibration routine to handle parallax errors and head movement, ensuring stable tracking across different users.

Technical Tasks

System Development:

- Use Python to stream data from eye-tracking hardware alongside EEG streams.
- Synchronize gaze timestamps with EEG stimulus onset for precise intent alignment.

Deliverables

- A Python-based application that visualizes real-time gaze overlays on a BCI command menu.

Learning Outcomes

By completing this project, students will:

- Understand the role of multi-modal fusion in reducing cognitive workload and user fatigue.
- Gain hands-on experience with eye-tracking hardware and spatial data processing.