MoBI-View: Real-Time, Extensible Platform for Multimodal Brain/Body Data Visualization

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Background & Motivation

- **Mobile Brain/Body Imaging (MoBI)** integrates brain and body imaging modalities—including EEG, eye tracking, and physiological monitoring—during naturalistic studies. [1]
- Enables study of brain function in ecologically valid, real-world tasks.
- **Current challenges in MoBI workflows:**
  - Difficulty monitoring multimodal data in real time.
  - Limited feedback during data collection.
  - Post-hoc discovery of data loss or sync issues.
  - Tools lack maintenance or only support single modalities.
  - Custom lab-specific solutions are common but non-reusable.
- LSL enables time-synchronized data acquisition [2] but lacks a cross-platform visualization tool.

Software Architecture

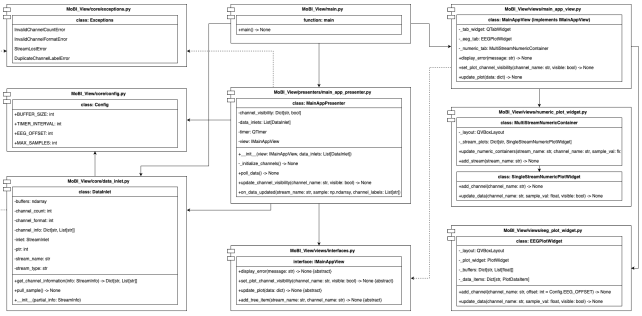

Figure 1: Module-level overview of the core components and their relationships within the Model-View-Presenter design pattern.

- **Model-View-Presenter (MVP) design**:
  - **Model**: *DataInlet* acquires and buffers LSL data.
  - **View**: *EEGPlotWidget*, *NumericPlotWidget*, and tree-based UI render interactive visualizations.
  - **Presenter**: *MainAppPresenter* routes data and handles UI logic.
- **Data flow:**
  1. LSL streams are auto-discovered and buffered.
  2. Data routed to appropriate plots based on type.
  3. Users toggle visibility via tree interface.

Key Features & Highlights

- **Automatic LSL stream discovery** for a wide range of sources.
- **Interactive stream management** for stream and channel toggling.
- **Tabbed layout** cleanly separates based on data types.
- Fully compatible across **Windows, macOS, and Linux**.
- **Low-latency updates (~50ms)** ensures near real-time feedback.
- **Rolling buffer** optimizes memory usage, reducing risk of overload.
- Includes **robust error handling** for both recovering from temporary stream interruptions and ensuring session continuity.
- **Lightweight UI**, usable even on computers without GPUs.

MoBI-View Platform

- **Unified interface** for synchronized multimodal stream display.
- **Real-time visualization** of EEG and physiological signals.
- **Modular design** for extensibility and ease of development.

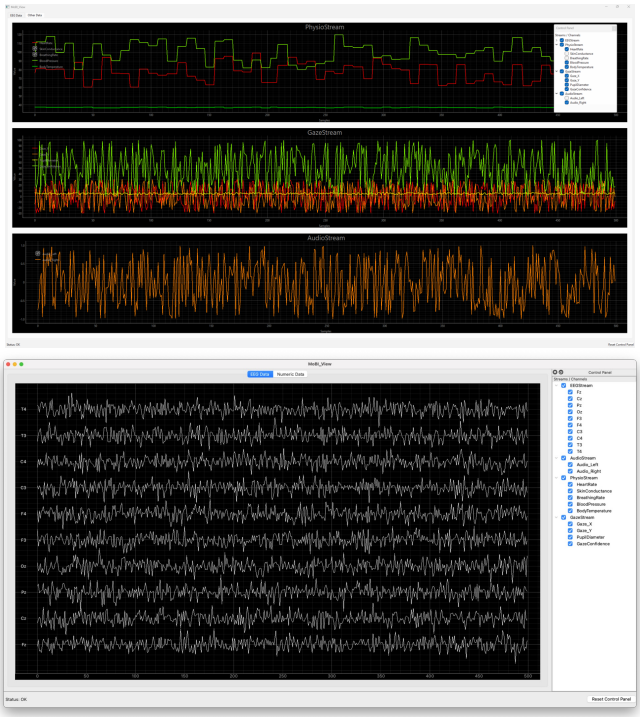

Figure 2: Top: Numeric Data Tab shows synchronized real-time signals from electrophysiological streams, each plotted in dedicated panels, operated on Windows OS.
Bottom: EEG Data Tab displays stacked waveforms from multiple EEG channels. Interactive channel selection and control panel shown on the right, operated on macOS.

Use Cases:

- Real-time monitoring and quality control during MoBI experiments.
- Cross-modality inspection with varying sampling rates.
- Protocol verification & training.

Future Directions

- **Signal processing capabilities:**
  - Real-time filtering and artifact detection.
  - Basic feature extraction (power spectra, heart rate variability, etc.)
- **Advanced visualization options:**
  - EEG channel impedance monitoring tab.
  - Synchronized video playback.
- **Enhanced quality control:**
  - Automated signal quality metrics.
  - Real-time alerts for poor signal quality.
- **Event marking and annotation**.
- **Plugin system for custom visualization modules**.

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References:

[1] Gramann, 2019 – Mobile Brain/Body Imaging (MoBI)

[2] Kothe, 2014 – Lab Streaming Layer (LSL)