Title

A Real-Time, Extensible Platform for Multimodal Brain/Body Data Visualization and Initial Processing

Authors and Affiliations

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Introduction

Mobile Brain/Body Imaging (MoBI) research seeks to understand neural activity as participants engage in naturalistic, free-moving behaviors. Such work often entails collecting electroencephalogram (EEG), motion capture, physiological signals, and other sensor data under variable and ecologically valid conditions (Gramann, 2019). Integrating, monitoring, and assessing these inputs in real-time presents a challenge, as existing tools commonly emphasize post-hoc analysis or single-modality visualization (Makeig et al., 2009). Real-time visualization and basic processing of diverse data streams facilitate immediate feedback, guide protocol adjustments, and minimize costly data loss. Prior MoBI experiments demonstrated the feasibility and benefits of capturing neural signals in real-world tasks (Makeig et al., 2009), but existing approaches rarely provide integrated, real-time multimodal feedback. Current alternatives, such as Stream Viewer (Intheon, 2016) and mobilab (SCCN, 2017) are limited by maintenance issues, high dependencies on external packages, and lack of live visualization.To address these limitations, we present MoBI-View, a standalone platform that utilizes the Lab Streaming Layer (LSL) (Kothe, 2014) to synchronize and visualize multiple data streams as they are acquired, with reduced dependencies on external packages. By displaying EEG, motion capture, and other sensor data together, this platform aims to provide researchers with immediate insights into data quality and consistency, offering a base for incorporating more advanced quality control (QC) and analytic methods.

Methods

MoBI-View is implemented as a Python application with a PyQt5-based interface, following a Model-View-Presenter architecture. Data streams are acquired through LSL, enabling concurrent synchronization of multiple data streams. Basic processing functions, including adjustable filtering and channel selection, support immediate quality assessments. The software's modular design encourages incremental integration of more advanced QC methods and analysis pipelines, and is well documented to facilitate contributions by external users. Thus, future developments can incorporate established QC strategies or tailored analytic algorithms without extensive refactoring.

Results

Preliminary evaluations of MoBI-View show reliable real-time visualization of multiple synchronized data feeds. The integrated view allowed early identification of unexpected packet

losses, connection issues, or external signal disturbances. Performance will be evaluated across various metrics, including synchronization accuracy, latency, system resource utilization, and user experience feedback. These evaluations will assess the platform's ability to maintain data integrity and operational efficiency under varying experimental conditions. The system's extensible architecture further sets the stage for integrating robust QC measures and analytic models, including those that have been explored in previous MoBI studies (Jungnickel et al., 2019).

Conclusions

MoBI-View offers a practical foundation for real-time, multimodal data integration and preliminary processing in MoBI research. By reducing reliance on post-hoc corrections and allowing immediate adjustments, data collection is aligned more closely with the intended experimental protocols. As additional QC and analysis features are integrated, we anticipate that the platform will further improve data quality, reduce the need for data re-collection, and enhance the overall efficiency and reliability of MoBI workflows.

Figures

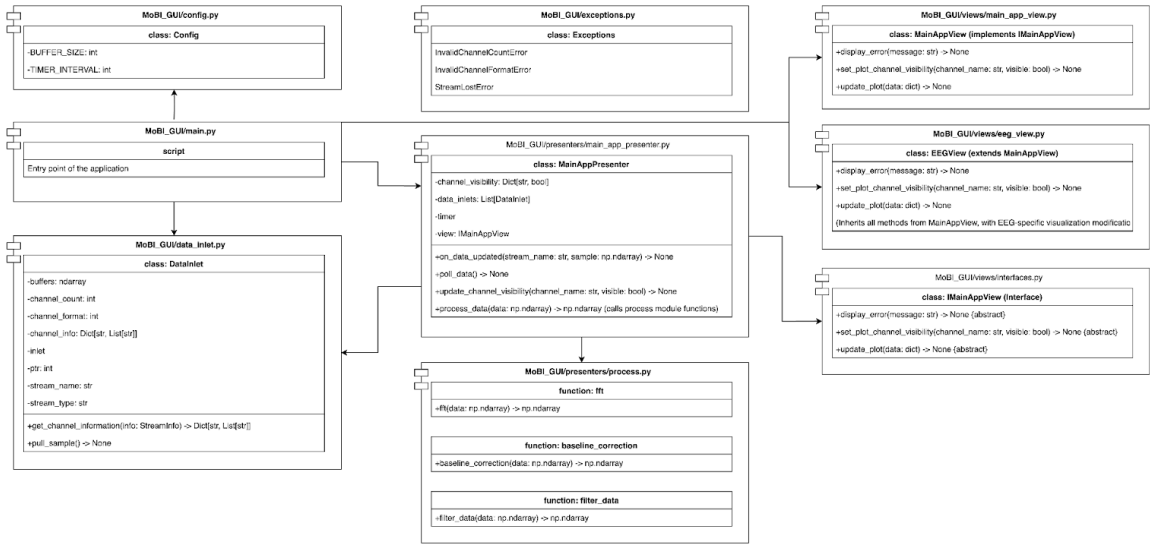

Figure 1: *Unified Modeling Language (UML) - style schematic of the MoBi-View architecture.* This diagram highlights data flow between Model-View-Presenter components, illustrating how LSL-based acquisition, visualization modules, and user-defined processing or QC routines interact within the system.

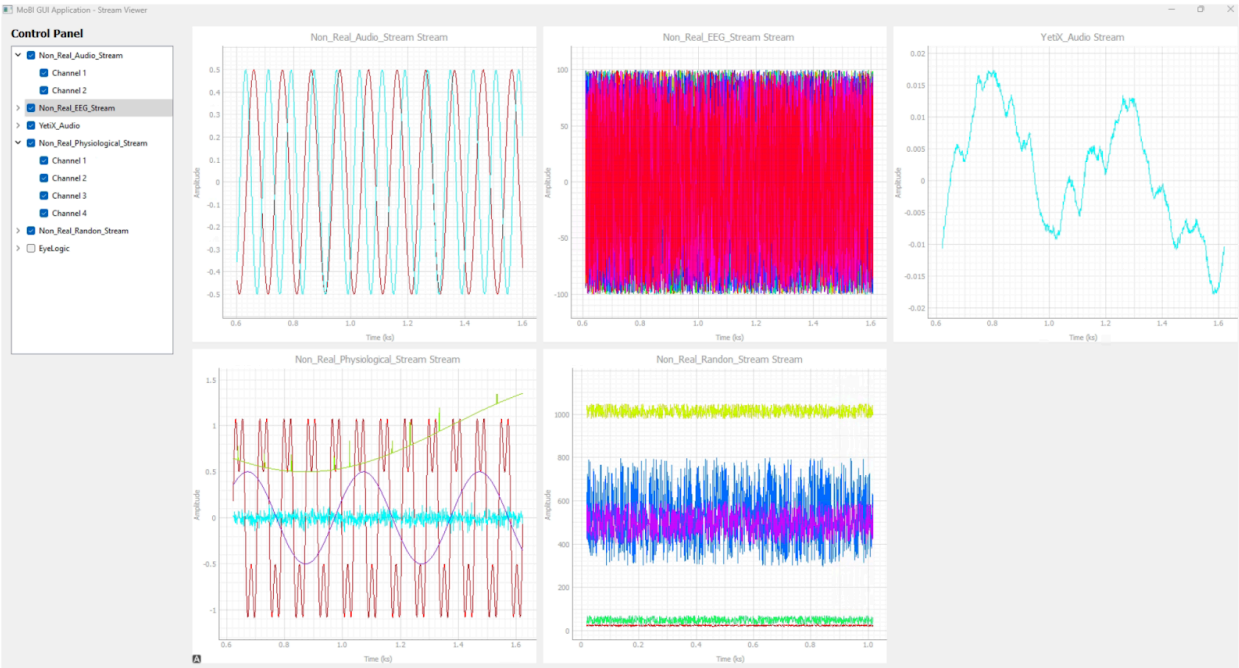

Figure 2: *A screenshot of the MoBI-View during an ongoing data collection session*. The interface shows sensor readouts and other integrated data streams, enabling real-time monitoring to ensure data quality and protocol adherence.

References

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Categories:

Primary: Multi-Modal Imaging

Secondary: Informatics Other

Methods Development, Multivariate Approaches, Workflows, Informatics Other, Multi-Modal Imaging

Keywords:
Computational Neuroscience, Data analysis, Data Organization, Electroencephalography (EEG), ELECTROPHYSIOLOGY, Multivariate, Open-Source Code, Open-Source Software, Workflows, Other (Mobile Brain/Body Imaging (MoBI))