The 2025 Student Research and Creative Works Expo

Gaze Insights in XR: Real-Time Eye-Tracking Analytics with Elasticsearch

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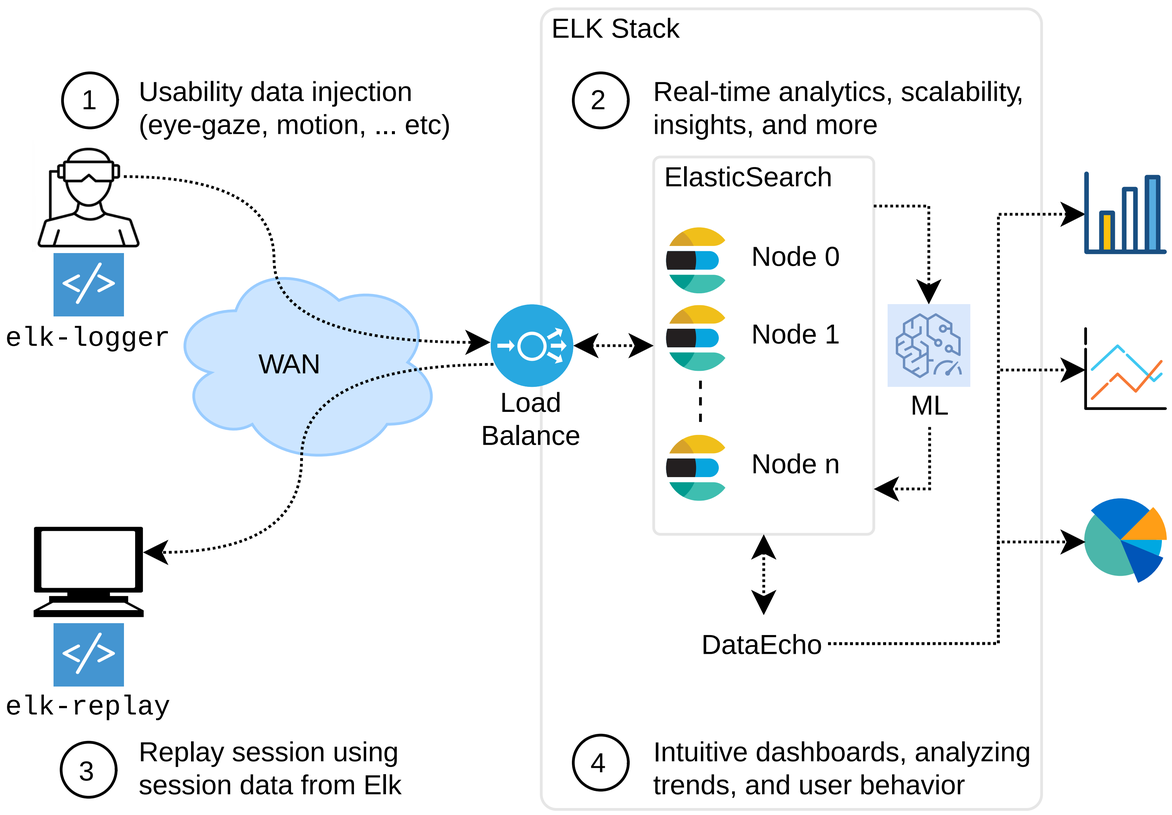
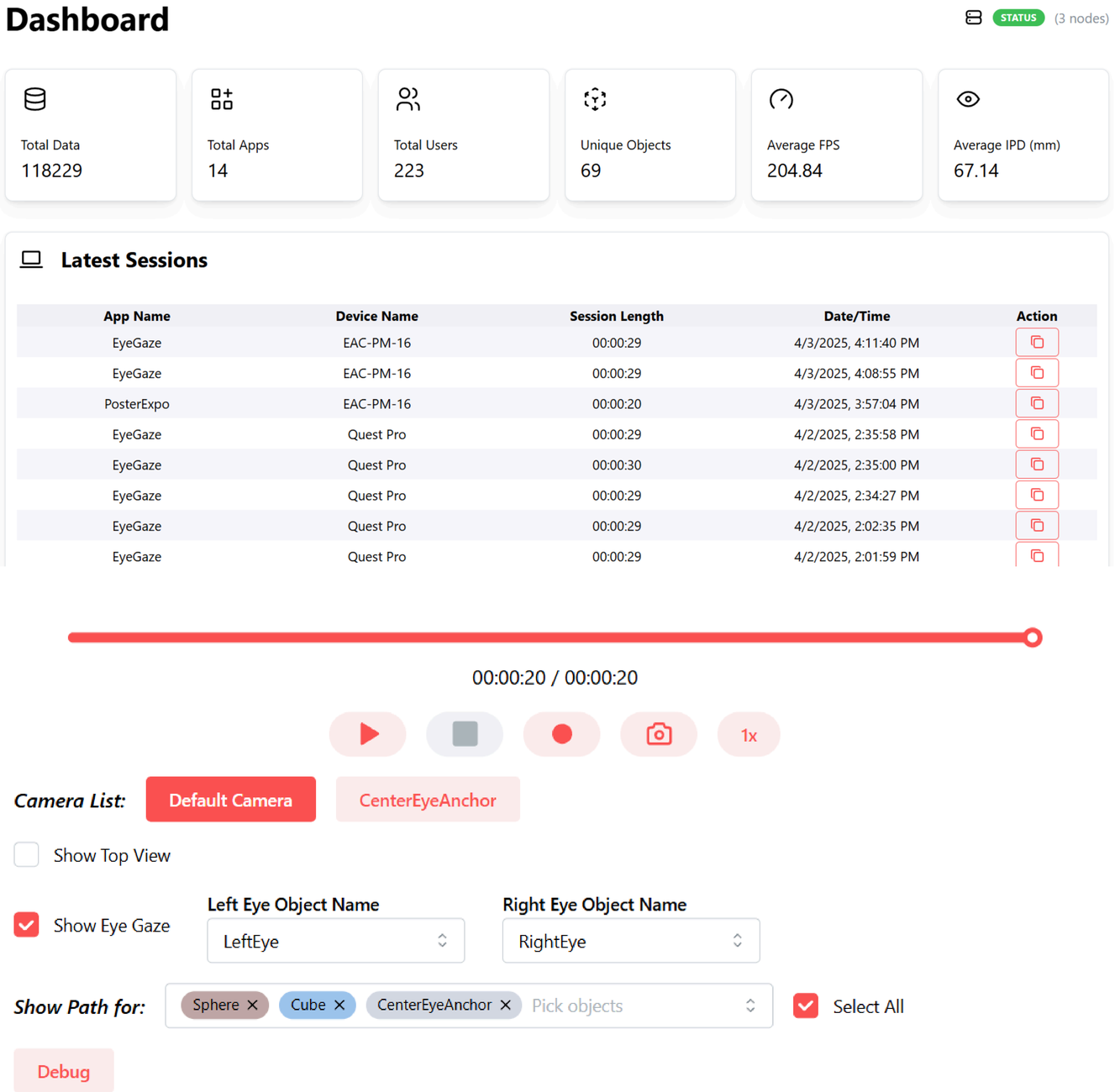
Overview

- Record any XR interaction data
- Enable session replay and analysis via DataEcho (web app)
- Use Elasticsearch for scalable storage and fast retrieval
- Supports usability studies and system behavior evaluation



System Architecture

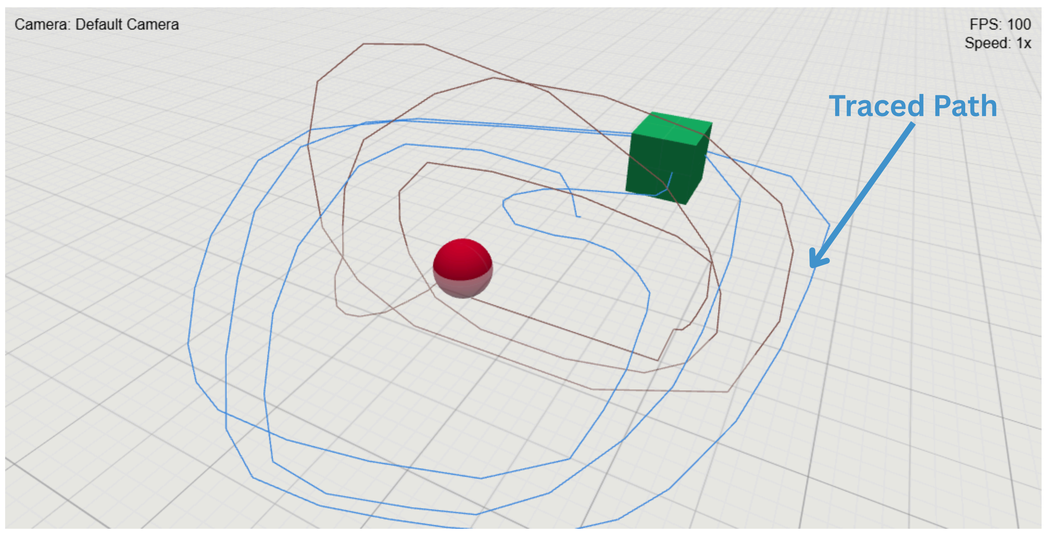


DataEcho dashboard and analytics controls

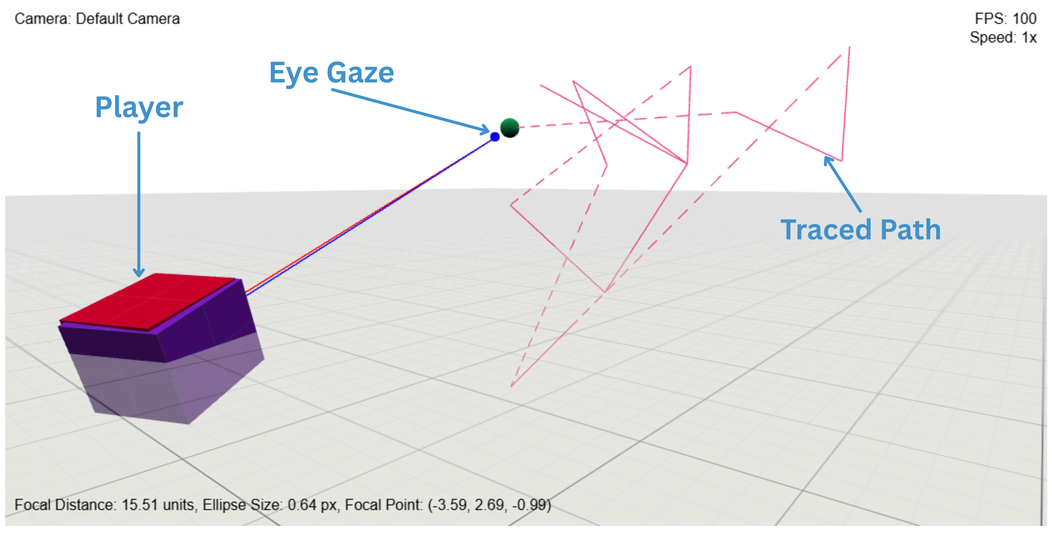
Analytics Interface

- DataEcho, an interactive playback tool for analyzing XR sessions, shows a comprehensive overview of stored data
- Play, pause, and scrub through recorded sessions
- Toggle between camera views
- Visualize eye-gaze rays and traced paths for selected objects

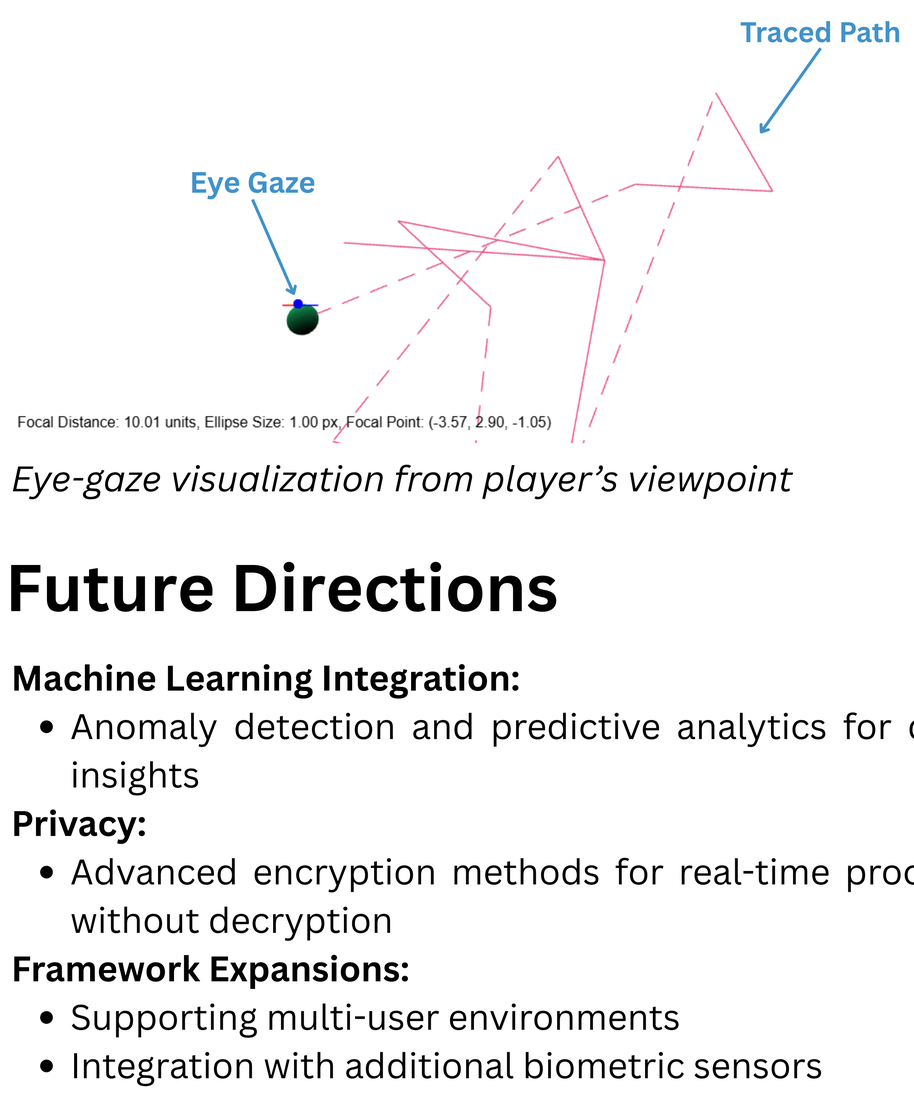
Replay Examples



Object movement traced in DataEcho



Eye-gaze of a player following a moving object



Eye-gaze visualization from player's viewpoint

Future Directions

Machine Learning Integration:

- Anomaly detection and predictive analytics for deeper insights

Privacy:

- Advanced encryption methods for real-time processing without decryption

Framework Expansions:

- Supporting multi-user environments
- Integration with additional biometric sensors

Conclusions

- Real-time, scalable pipeline for interaction and gaze data
- ElasticSearch backend enables efficient recording
- DataEcho provides analytics and visualization
- Enables adaptive XR user behavior studies

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