



Mobile VR Lab

For Immersive Educational Experiences



Team Members:

Catrina Janos
Hannah Marsh
Kate Keefe
Adam Hassick

Project Sponsors:

Tom Butkiewicz and Drew Stevens

INTRODUCTION:

- Traditional educational methods fall short in conveying data-rich subjects like oceanography.
- Our project introduces an immersive VR tool designed for classroom use, which combines self-contained VR headsets, an instructor application for streamlined content management, and a dedicated server to ensure smooth connectivity.
- This innovative solution is tailored to enhance student engagement and deepen their understanding of intricate subjects.
- Our solution provides value by rendering highly detailed models to many students without relying on a high bandwidth internet connection, unlike other solutions.

REQUIREMENTS:

Functional Requirements

- Hand gesture navigation and virtual safety boundaries
- Visual highlights on important objects and pupil distance adjustment guidance
- Real-time scene management by instructors
- Attention capture feature for instructors
- Dynamic script loading
- Clickable elements in scripts

Non-Functional Requirements

- Intuitive UI for all users
- Preloaded models for smooth operation
- Compatibility with Quest 3 headsets and Android tablets
- Rendering models with > 30,000 vertices
- Rendering models with 4K textures

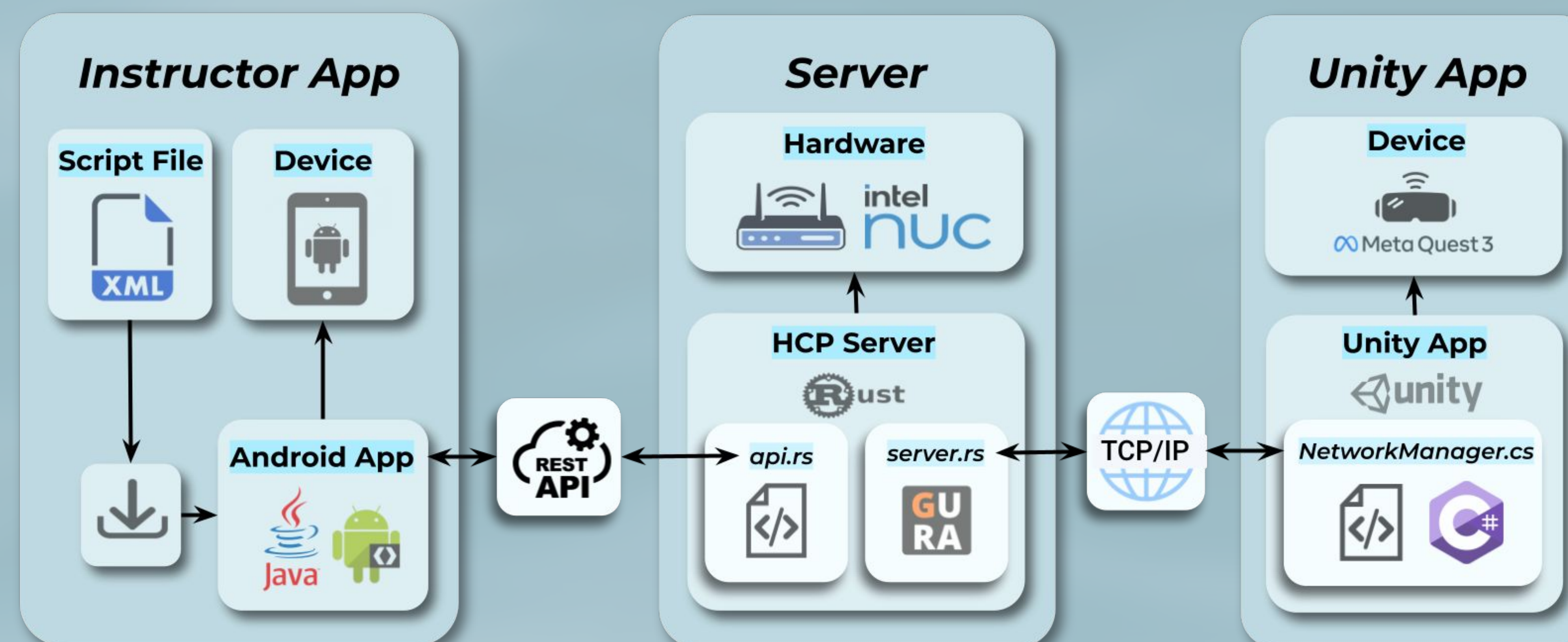
Security Requirements

- Access control and air-gapped design
- Trusted device whitelist for connections

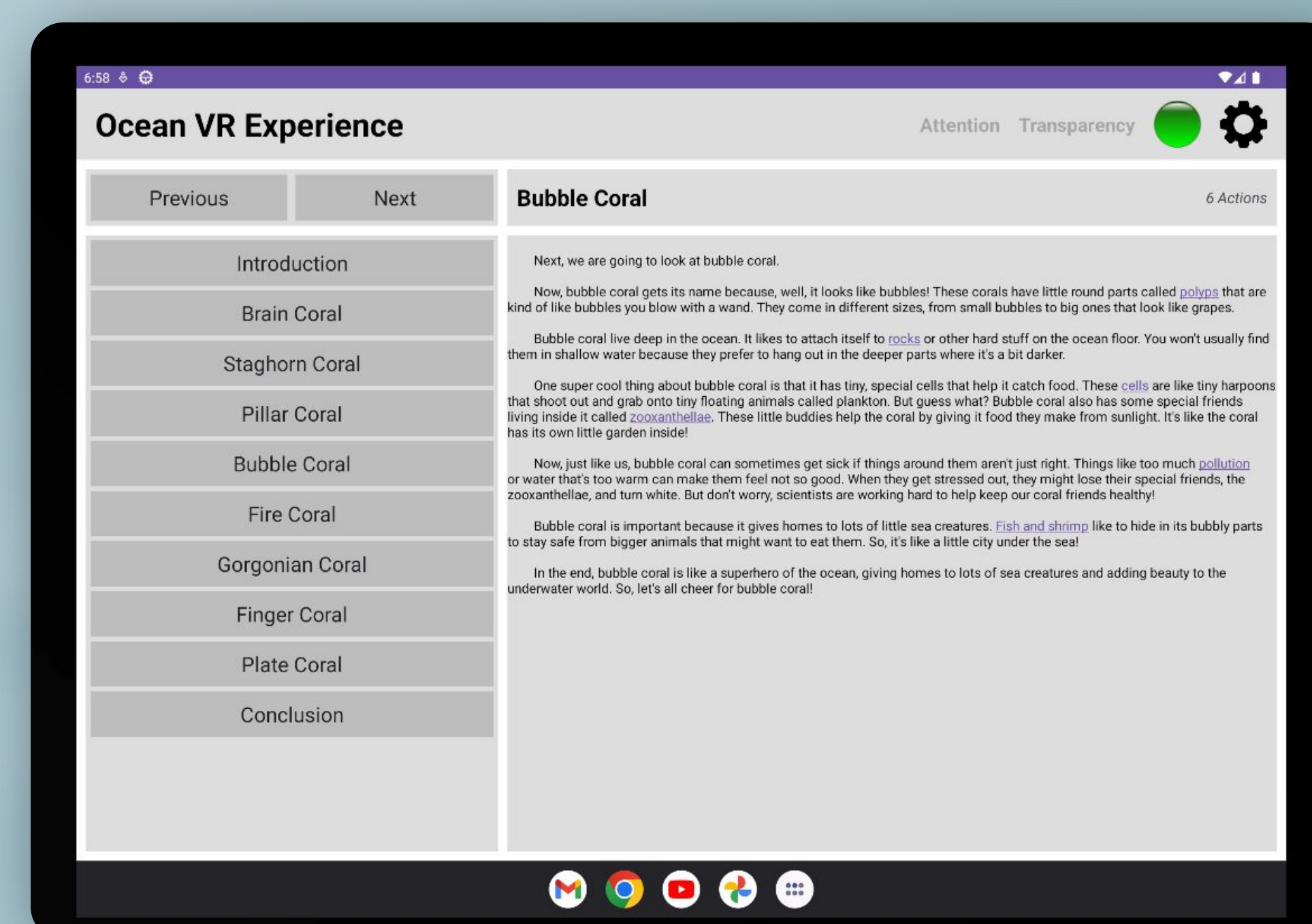
DESIGN & IMPLEMENTATION:

- Instructor App:** Empowers instructors with real-time monitoring capabilities and the ability to dispatch commands efficiently using the REST API, which smoothly bridges the gap between the Instructor App and the HCP Server with simple message communication.
- Server:** Acts as the central hub, aggregating data from and dispatching instructions to VR headsets. It provides the REST API to the app using the Poem web framework, maintains direct and stable connections with VR headsets using our Headset Control Protocol (HCP) server, and tracks the connection health and number of headsets connected.
- Unity App:** Renders immersive VR content in alignment with server directives, conforming to strict Exhibit Specification and Configuration protocols. It enhances the user experience by leveraging the Meta Interaction SDK, enabling the use of hand gestures rather than traditional controllers.

System Architecture



Instructor App User Interface



Unity Flashlight Interaction, Coral Reef



TESTING & RESULTS:

- Our testing framework includes unit tests for specific code segments, alongside integration and user testing to evaluate system performance.
- The Android Application efficiently processes dynamic interactive XML scripts, offering instructors capabilities to view, navigate, and highlight scene elements.
- The Server Application facilitates smooth communication between the instructor app and the VR interface, also tracking connected headsets.
- The VR Application leverages Meta's Interaction SDK for hand tracking, allowing for object interactions within scenes.
- The HCP server is able to maintain 35 connections with RTT < 200 ms with mock clients over a loopback network interface.
- A system demonstration was performed with two Meta Quest 3 headsets utilizing a wireless access point for networking.

CONCLUSION:

Our system aims to achieve:

- A round-trip time < 2 seconds for instructor commands with ≥ 3 clients (95% of sessions).
- Render high-polygon 3D models at 60 FPS for visual fidelity and immersion.

Current system achievements:

- Enables interactive content on Quest 3 and facilitates instructor lesson management.
- Operates efficiently over an isolated LAN.

Testing and refinements are ongoing to meet these standards. If not met, waiting for improved VR headsets, hardware upgrades, or changing the game engine may enable the project to succeed.