AR Mural

Riyana Chaudhary, Ethan Yung, and Heeun Kim

Overview

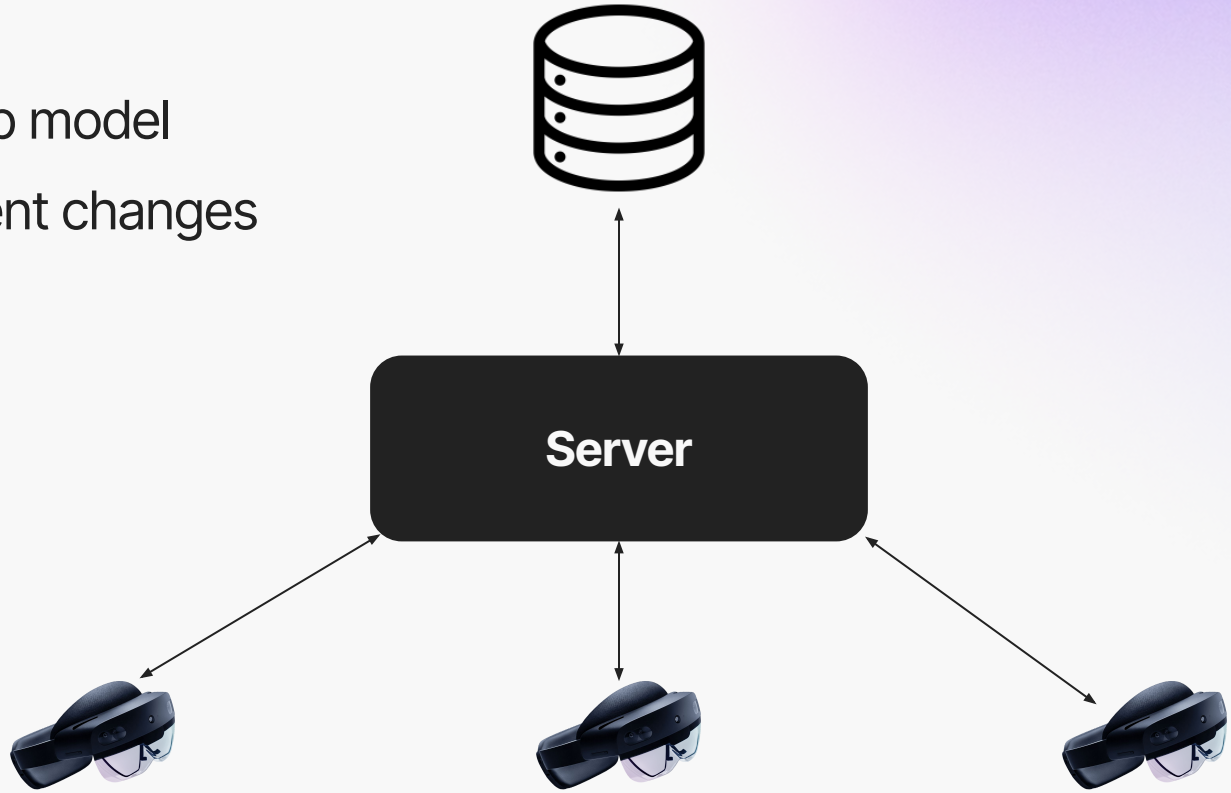
Create a **3D multiplayer drawing app** where users can work on art pieces together.

↳ on the Hololens 2

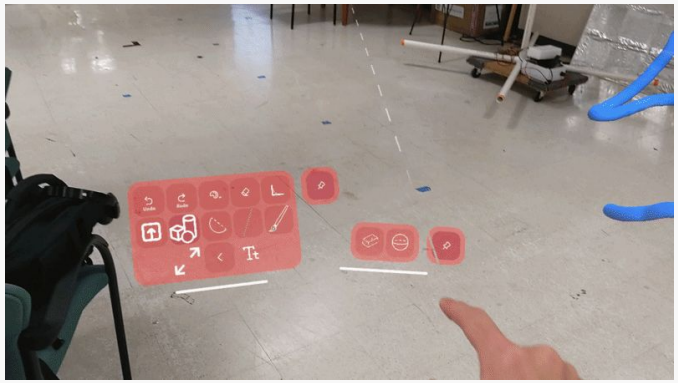
↳ using Unity

Project Structure

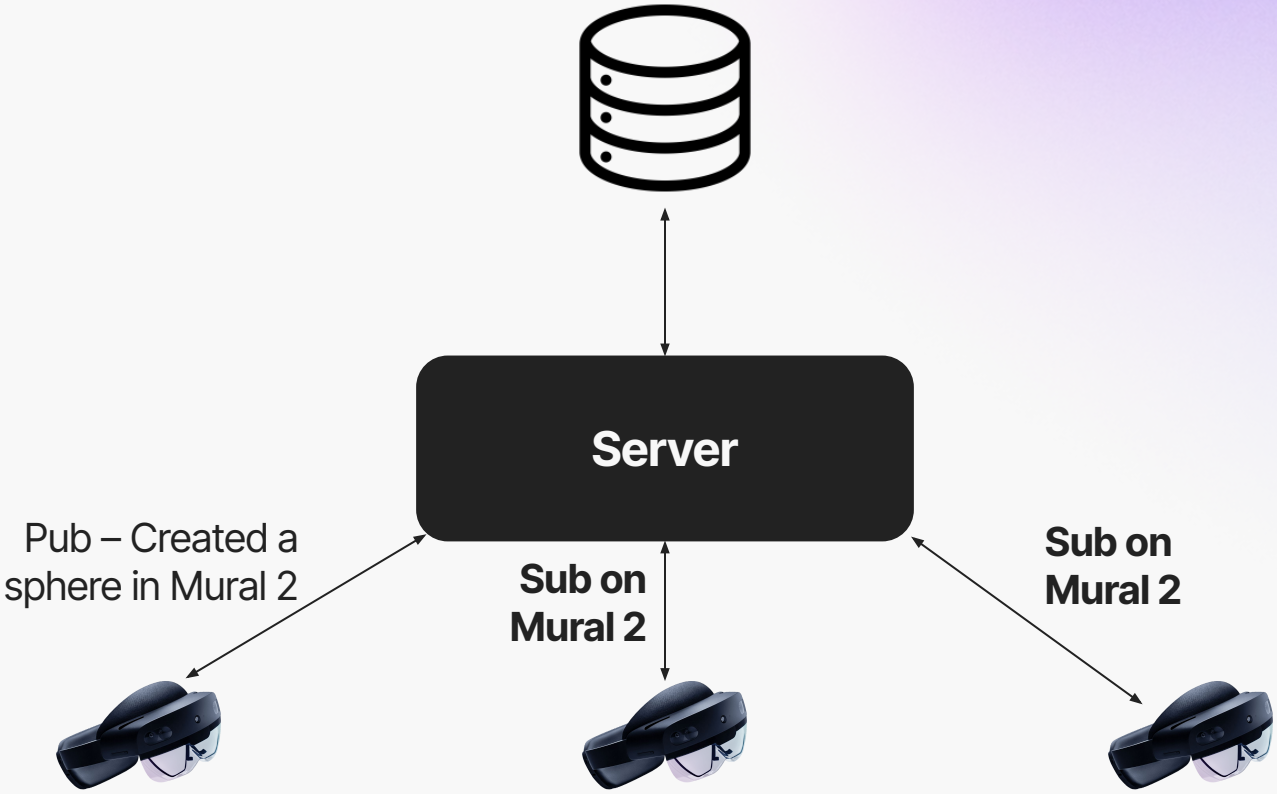
- Pub-sub model
- Persistent changes



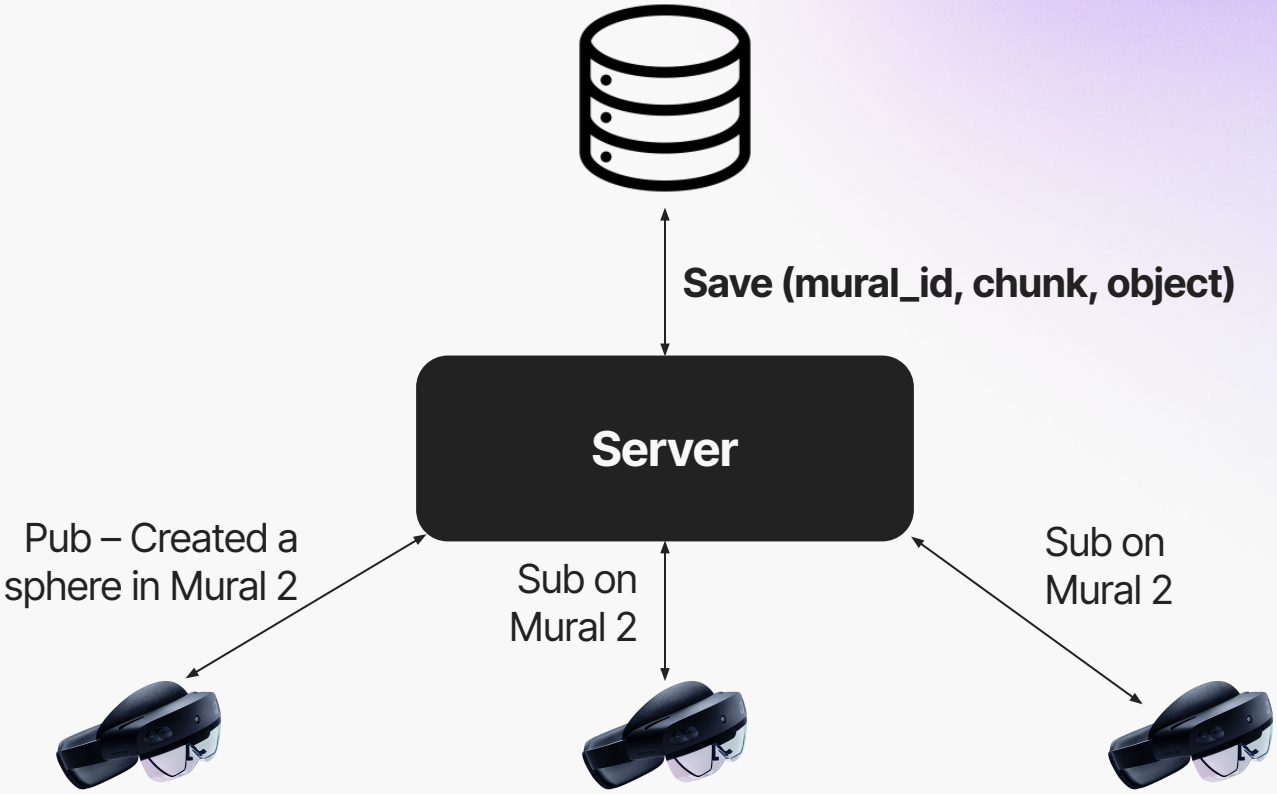
Project Structure



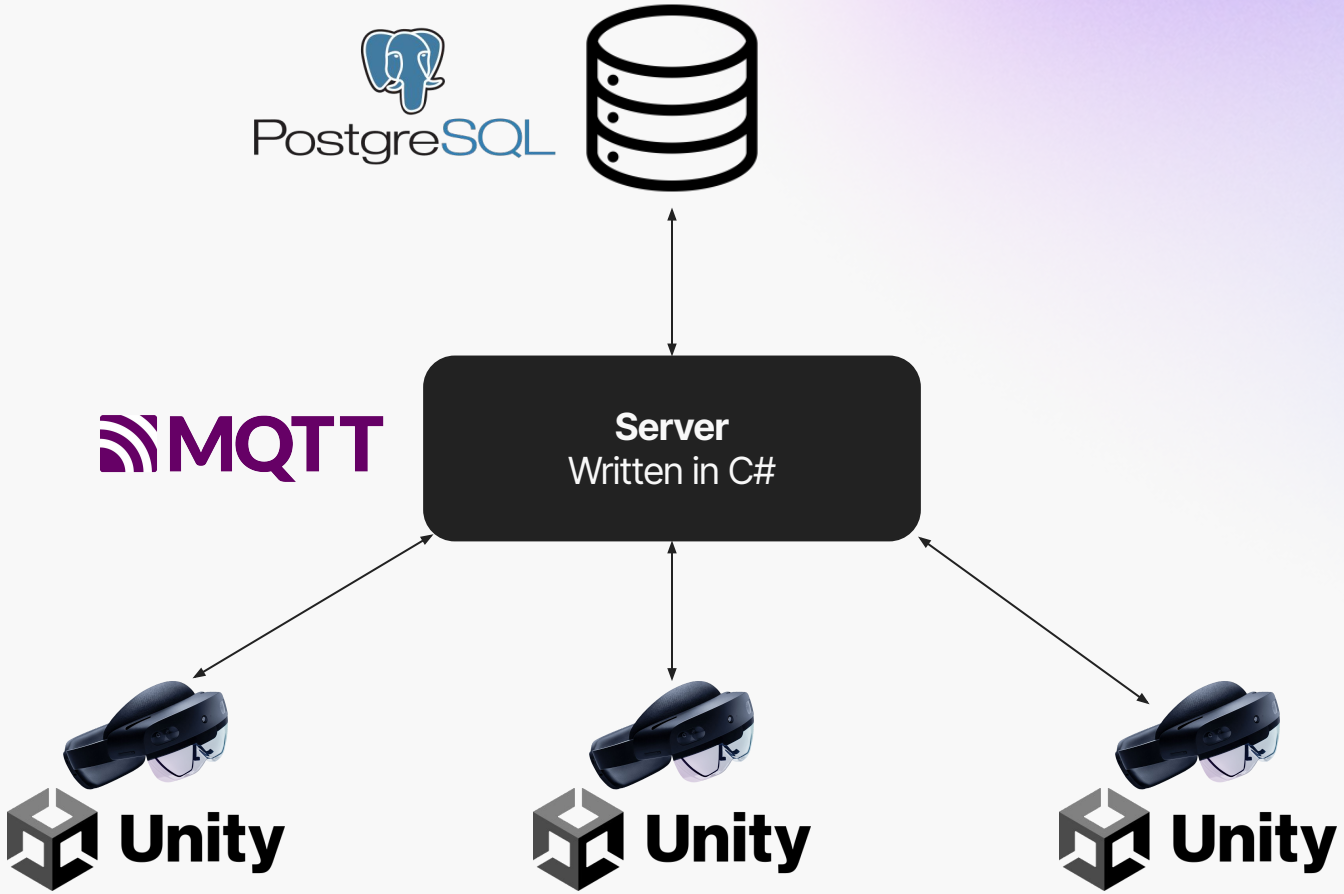
Project Structure



Project Structure



Project Structure



Technologies (Client)

Unity (2022.3.30f1)

Popular game engine that supports VR/AR applications.

MRTK3

- Open-source SDK for AR/MR applications.
- Provides developers with access to device features (hand and eye tracking).

Visual Studio 2022

Integrated development environment used to edit, build, and deploy apps to the headset over Wi-Fi

Technologies (Server)

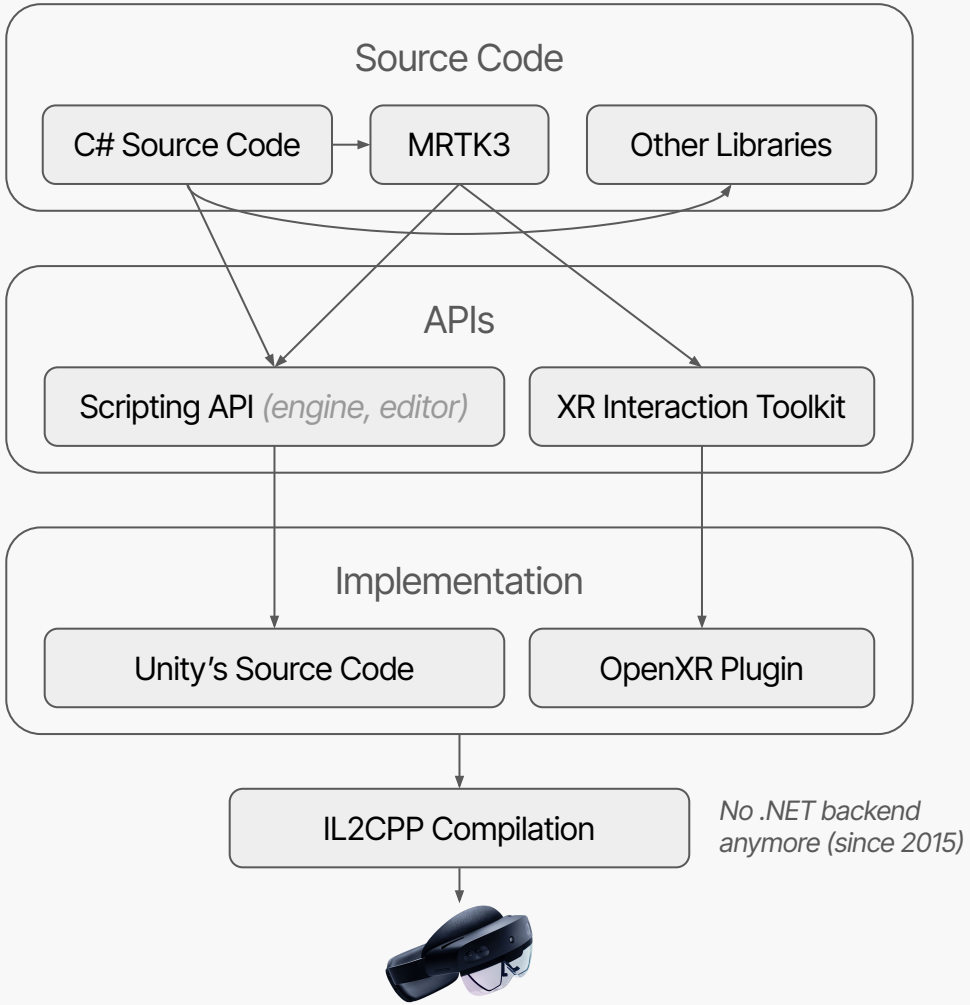
MQTT Broker

- Pub-sub communication protocol
- Provides communication between Hololens for multiplayer functionality
- Broker stores all updates to murals in database

PostgreSQL Database

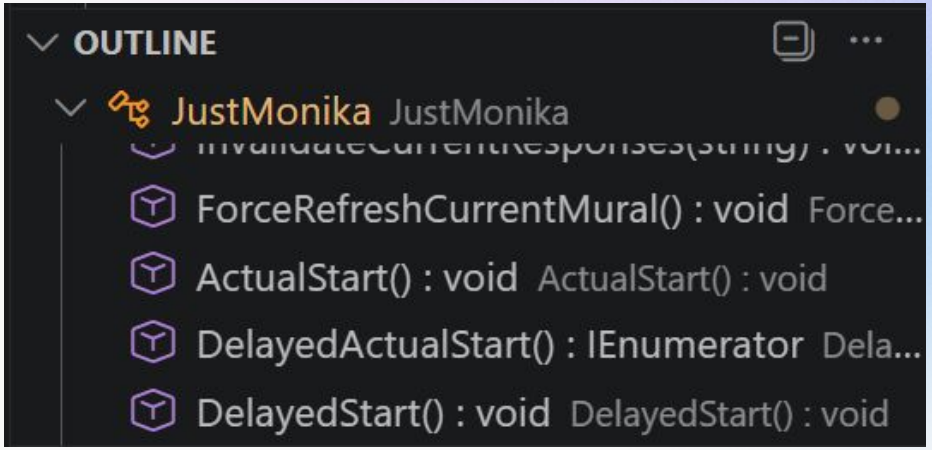
Used to store changes to murals.

Unity App Architecture



Obstacles

1. Multiple bugs in core code
2. Inefficient previous code
    a. Odd workarounds and repetition
3. Lack of documentation
4. AI requires detailed prompts



Contributions

1. Fixed misalignment / QR code initialization
    a. All tools refactored
    b. Avatar positioning
2. Minimized scene switch lag
3. Optimized mural chunk generation
4. Developed documentation for each error and solution
5. Developed overview of important files

Canada-USA Border

Initialized Headset in Canada

Initialized Headset in USA

QR Code Initialization

Load *Main* Scene

↓

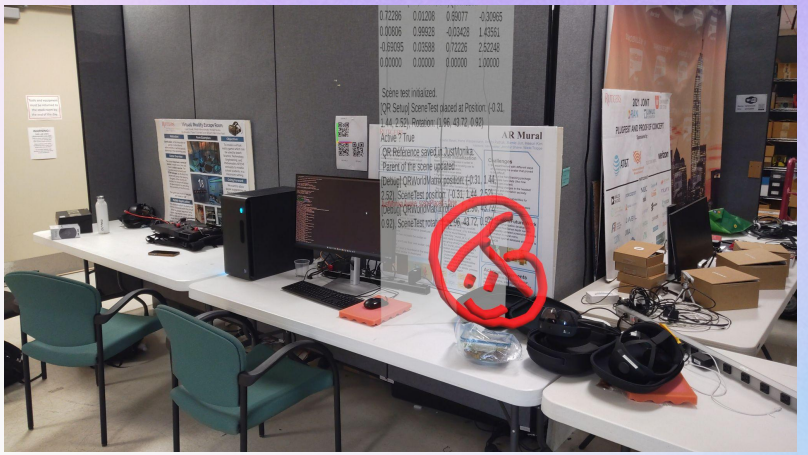
Scan 3 QR Codes & create QR frame

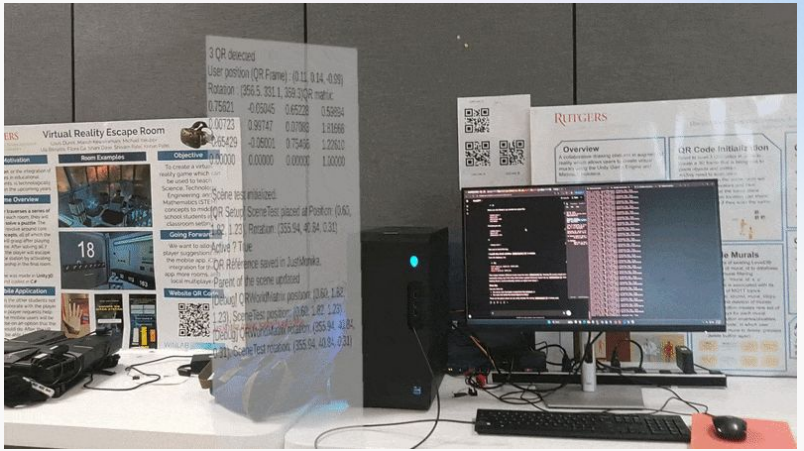
↓

Generate objects in mural

Previous Problems

- Reference Frame is off 1.6 meters
- Unity world-space coordinates sent to server
    - Different scanning positions = different object placement





Our Fixes

- In every Tool, we transform world-space coordinates into QR frame local-space coordinates
- When objects are regenerated, we set their parent as the QR frame OriginAnchor
    - Unity automatically transforms them to world-space
- Changed offset to zero for MRTK XR Rig (fixed the 1.6 meter error)

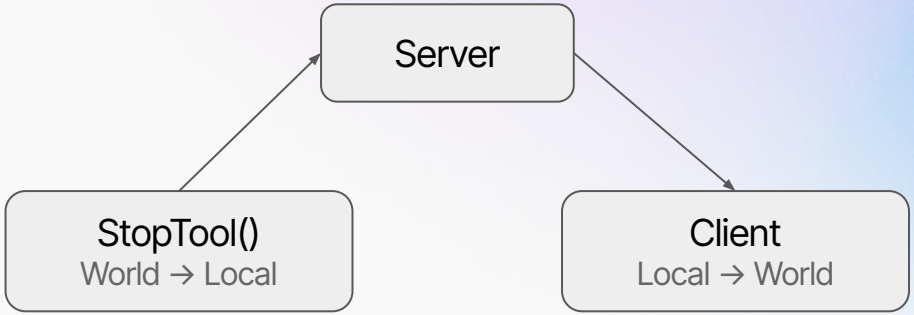
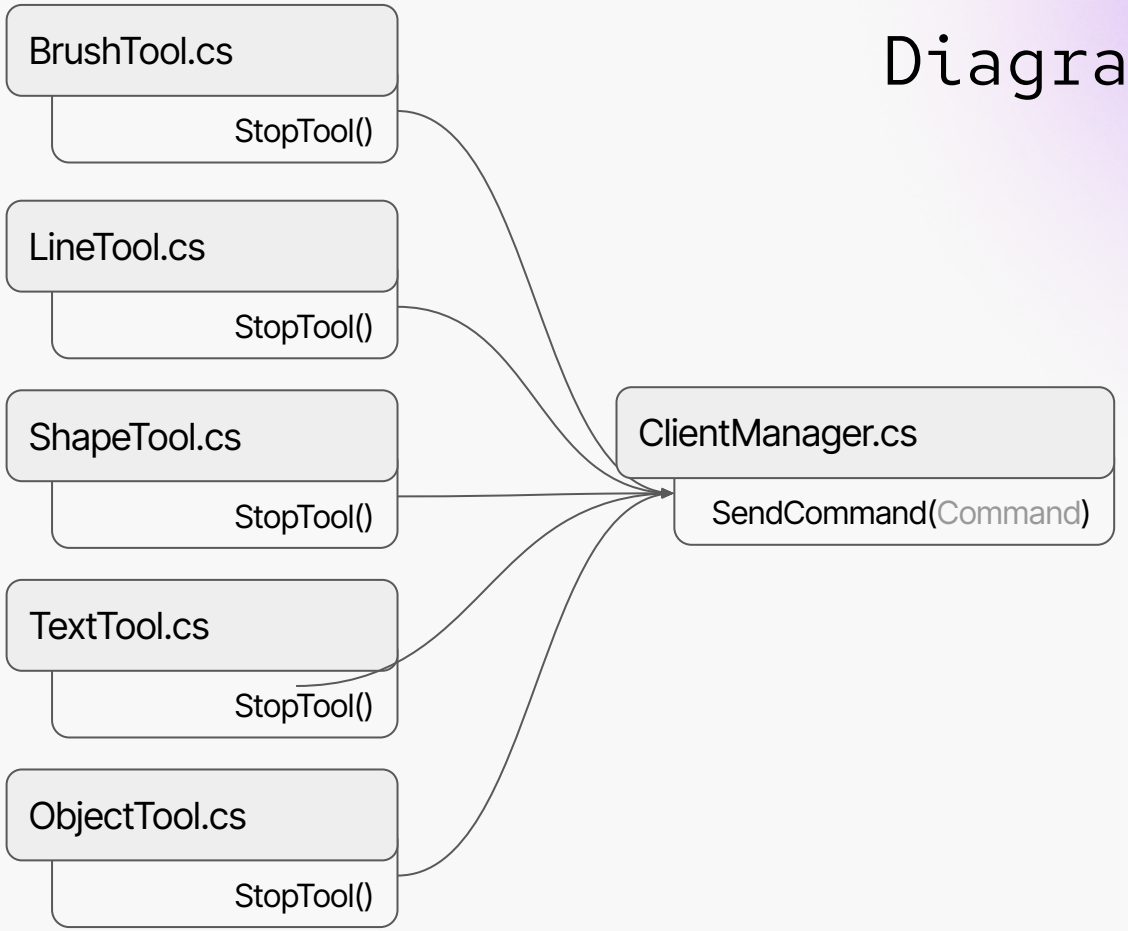
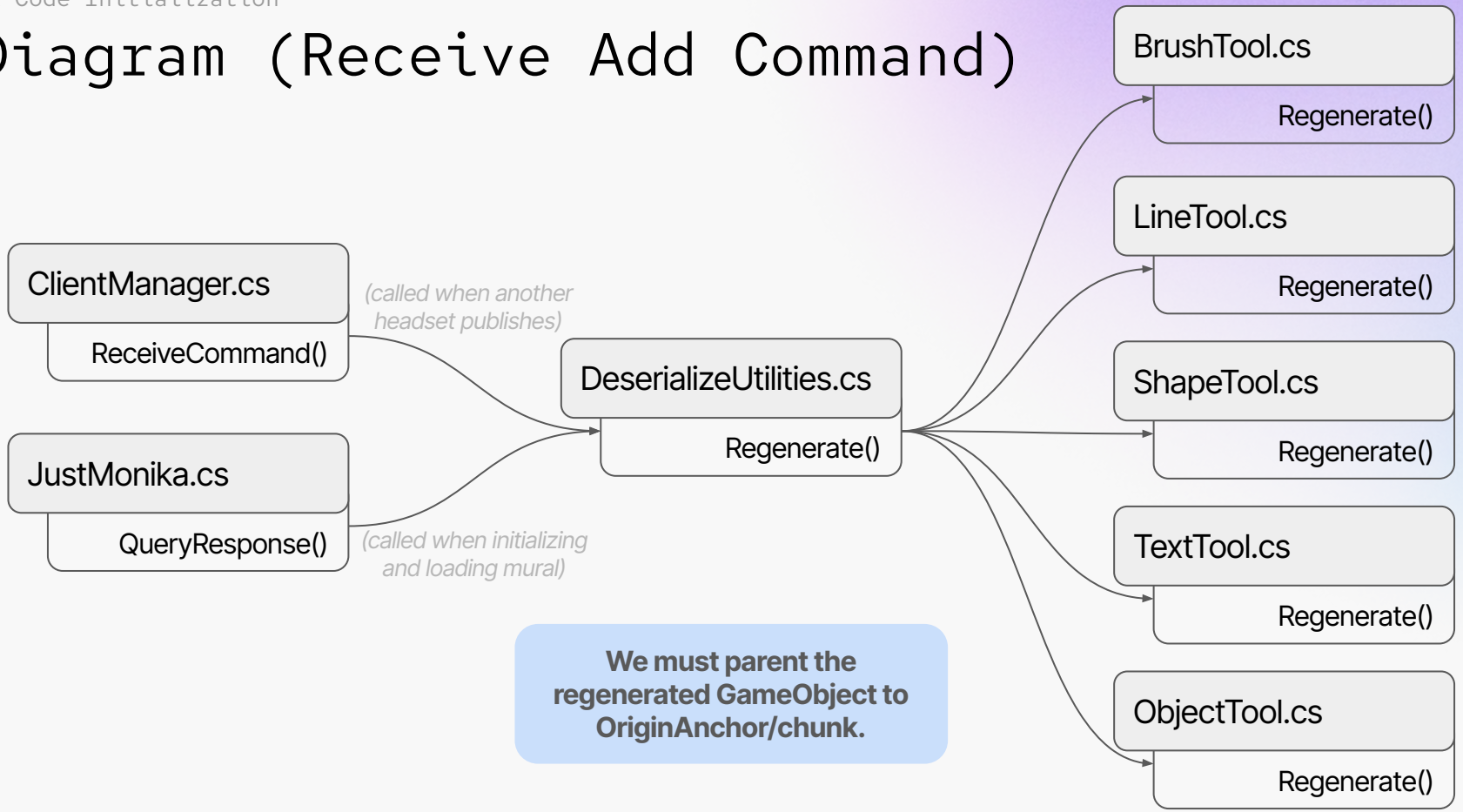


Diagram (Add Command)



The coordinates sent in Command must be QR frame local-space coordinates.

Diagram (Receive Add Command)



QR Code Initialization

Avatar Positioning

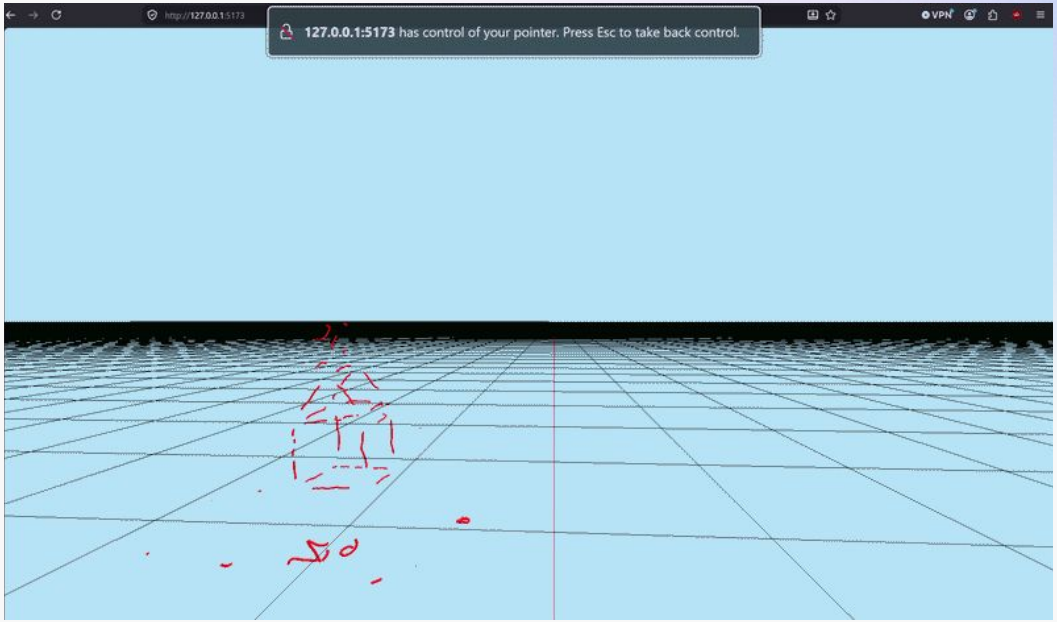
[insert GIF of avatar in wrong position]

[insert GIF of avatar in correct position]

Visualization Debugging Tool

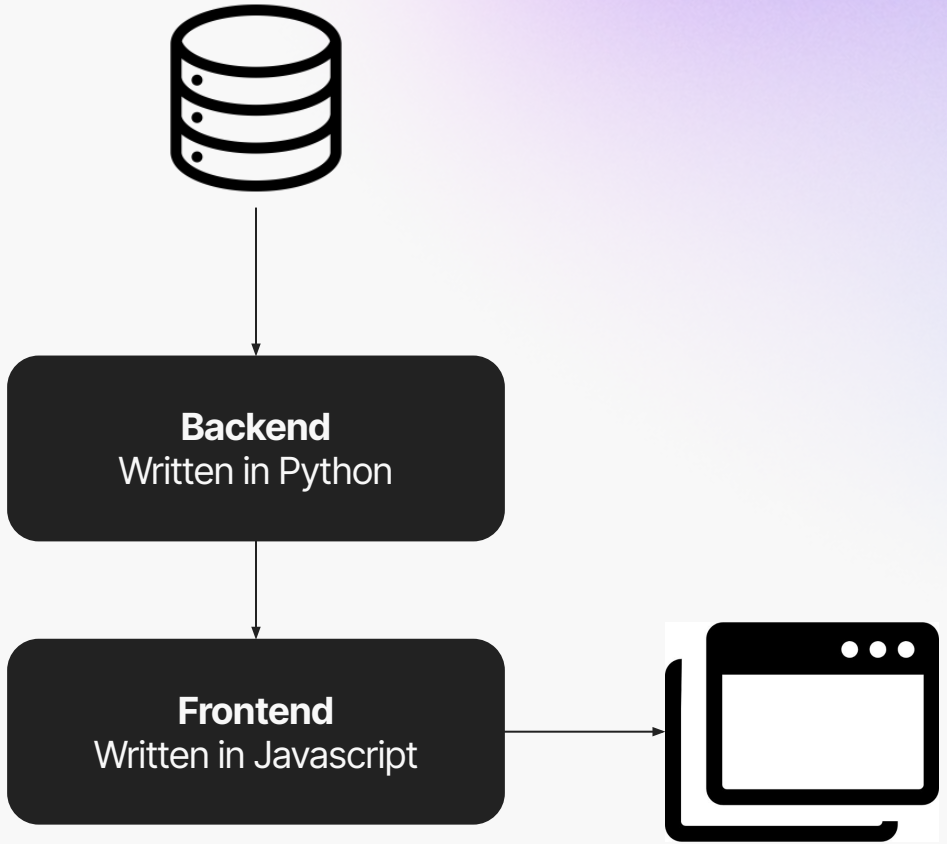
Overview

- Create a website to display mural objects
  - Using Python backend
  - Using Three.js



Project Structure

- Uses Psycopg2 to access database
- Uses Flask for API routes
- Uses Three.js to display 3D objects



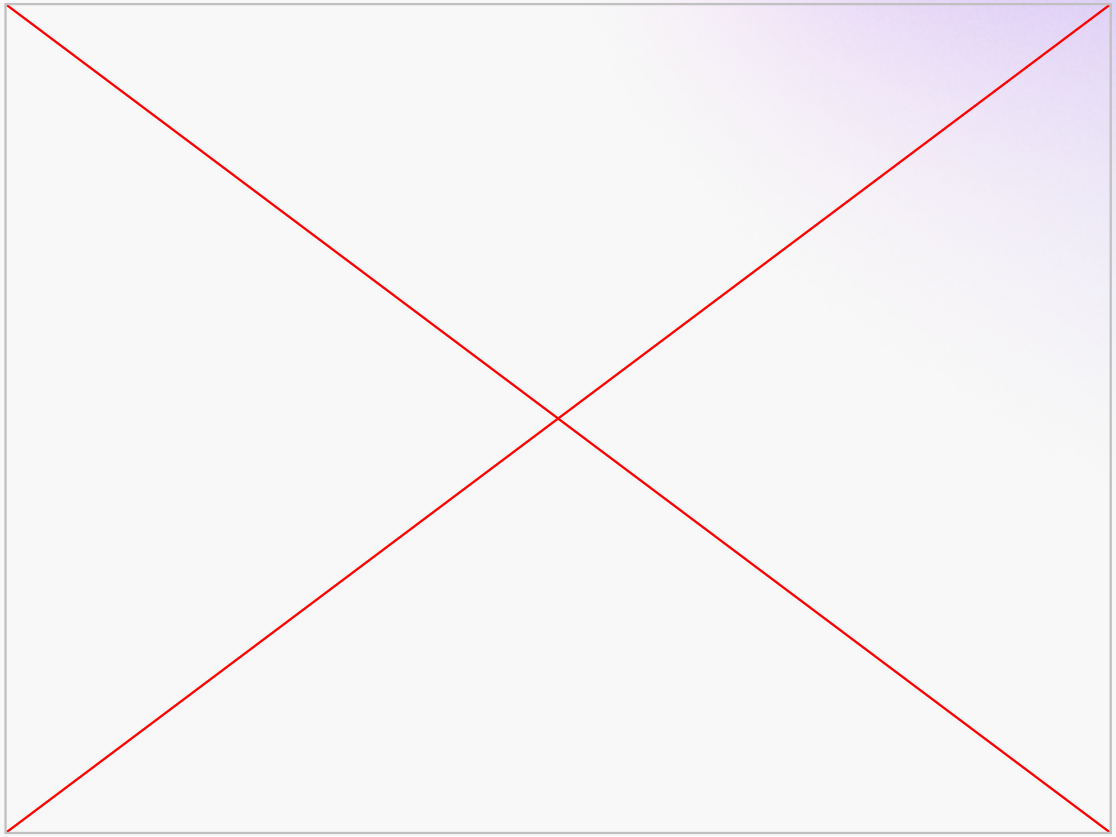
Menu→Main Scene Switch

[insert image of choosing mural id]

Mural Chunk Generation

[insert image of mural loading in w/ chunk borders on]

Documentation of Deployment Errors



Contributions

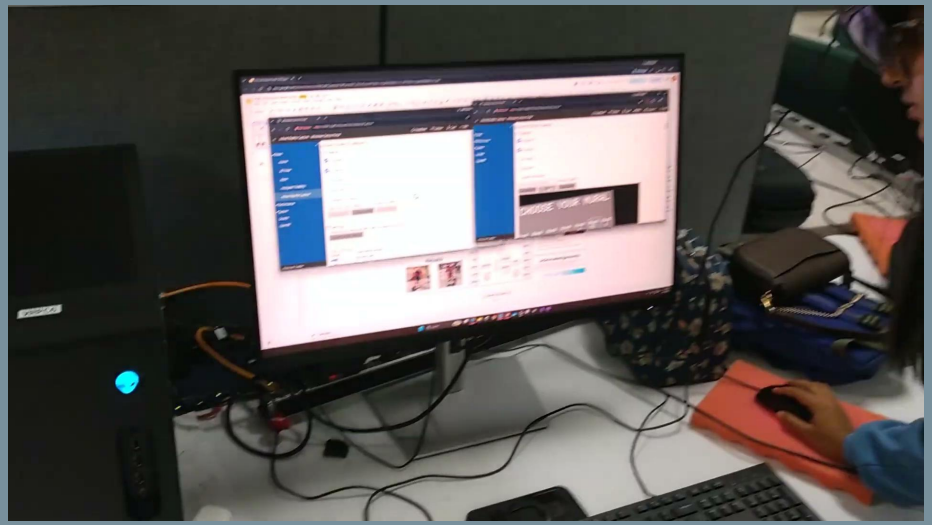
Fixed misalignment / QR code initialization

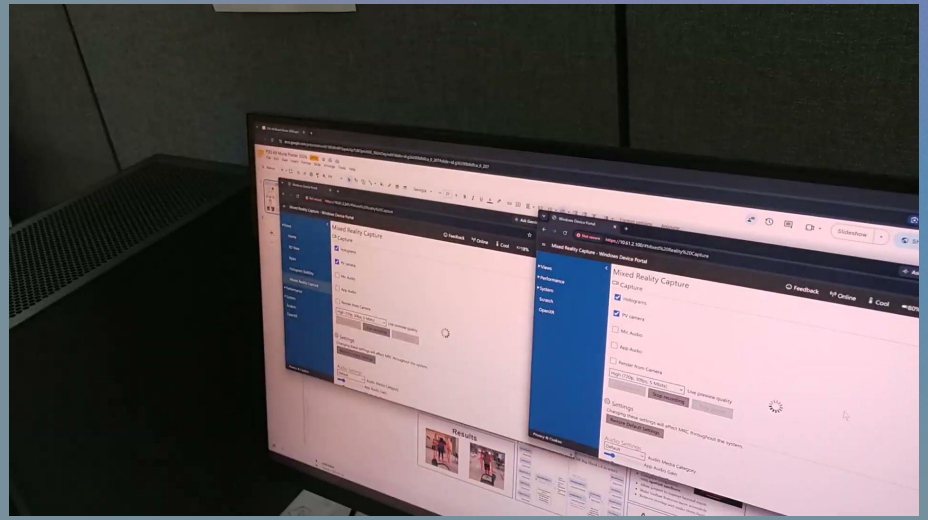
Minimized scene switch lag

Optimized mural chunk generation

Developed documentation for each error, solution and important file

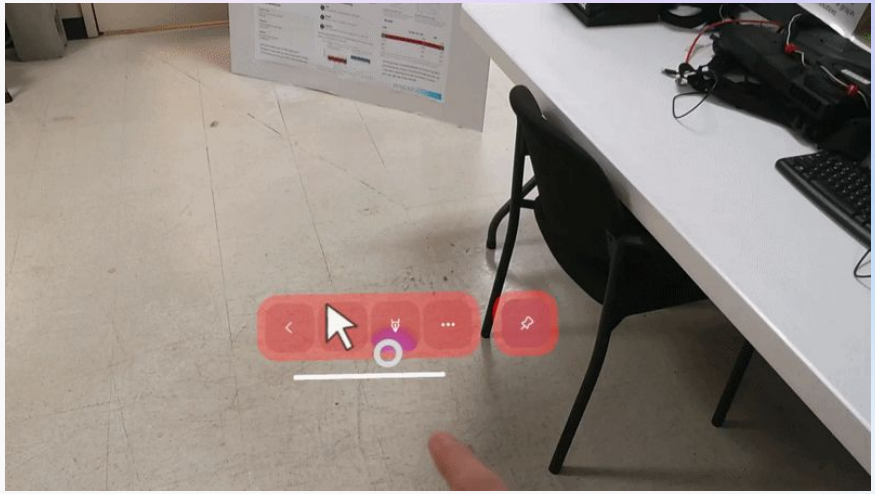
Demo





Future Directions

1. Continue to improve latency
    a. Benchmark speed improvements
2. Complete integration to spatial anchors
3. Improve accessibility of toolbar features



Thank you!

- **AR Mural**: 3D he multiplayer drawing app on Hololens 2
- **Fixed misalignment issues:**
  - Refactored all tools to send local-space coordinates
  - Parented regenerated GameObjects on OriginAnchor.
- **Visualization Website**

Our Wiki:

Riyana Chaudhary
Rutgers CS; Class of ‘29

Ethan Yung
Rutgers ECE; Class of ‘29

Heeun Kim
High School