RoomRender: a WebGL-based Interactive Room Editor

Master's Degree in Artificial Intelligence and Robotics

Interactive Graphics Course

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SAPIENZA
UNIVERSITÀ DI ROMA

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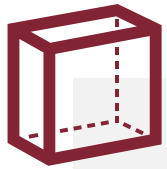
Introduction

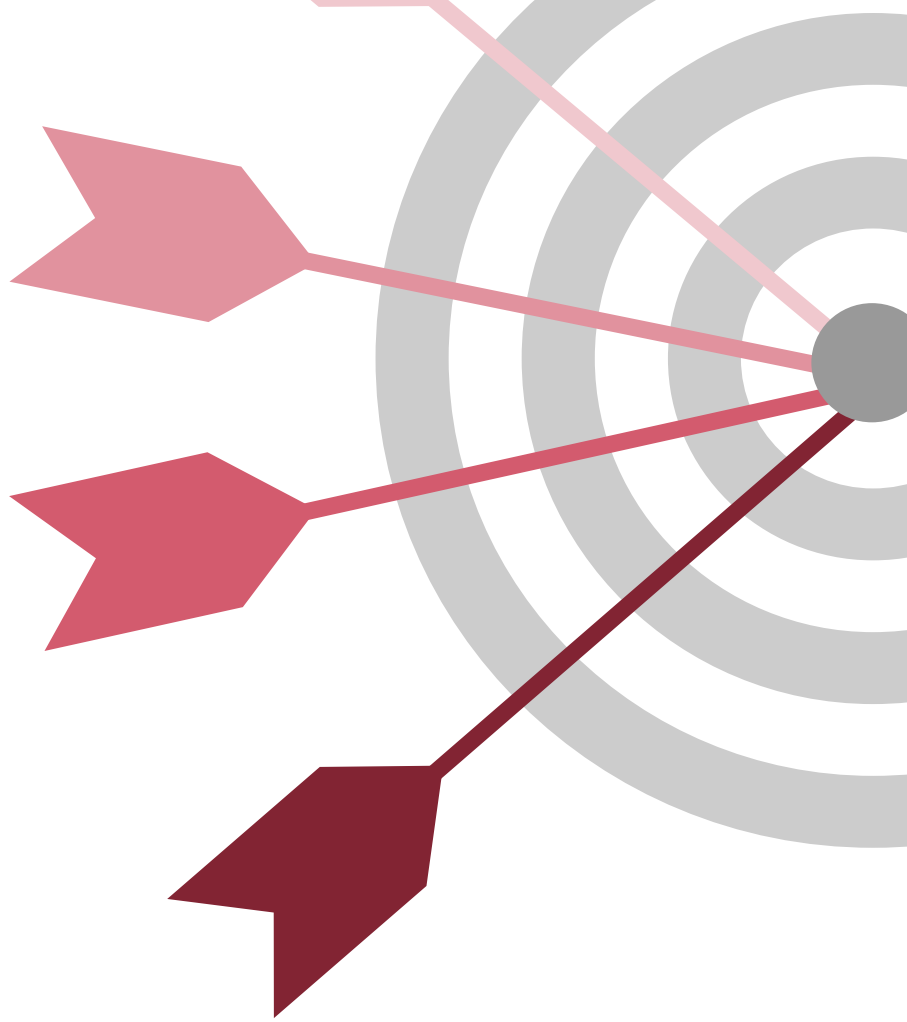


Interactive 3D room rendering enables users to design and visualize indoor spaces in real-time, transforming traditional interior planning into a dynamic digital experience.

Thanks to **WebGL**, web-based applications can now render complex 3D scenes directly in the browser, eliminating the need for plugins or dedicated software.

Modern UI design and real-time material and lighting customization make interior design tools more accessible, engaging, and user-friendly for both casual users and professionals.

Work Focus



Build a **3D room editor** powered by WebGL, capable of running directly in the browser. It allows users to create and **customize indoor environments** by editing floors, walls, and furniture, while providing real-time control over materials, textures, and lighting. To improve usability, the tool features intuitive **camera navigation**, support for external 3D model importing, scene export/import, and an AI design assistant that offers layout tips and visual suggestions.

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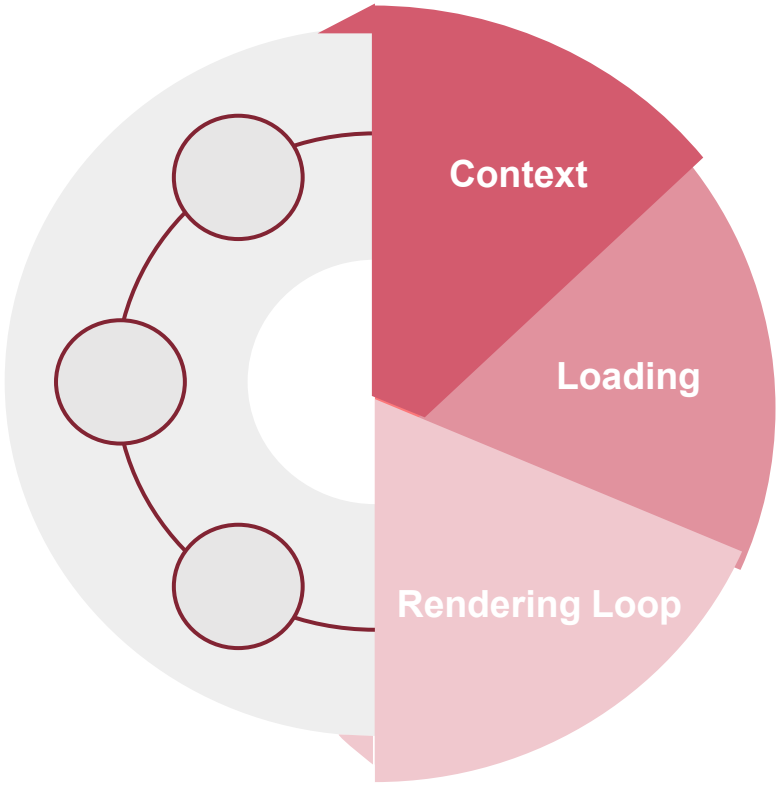
Main

Connection of all the key modules: renderer, scene manager, camera, UI manager, and input system, ensuring that everything runs smoothly inside a real-time rendering loop



Context

Initialization of the WebGL rendering context, setting up key modules (renderer, scene, camera, UI, input).

Loading

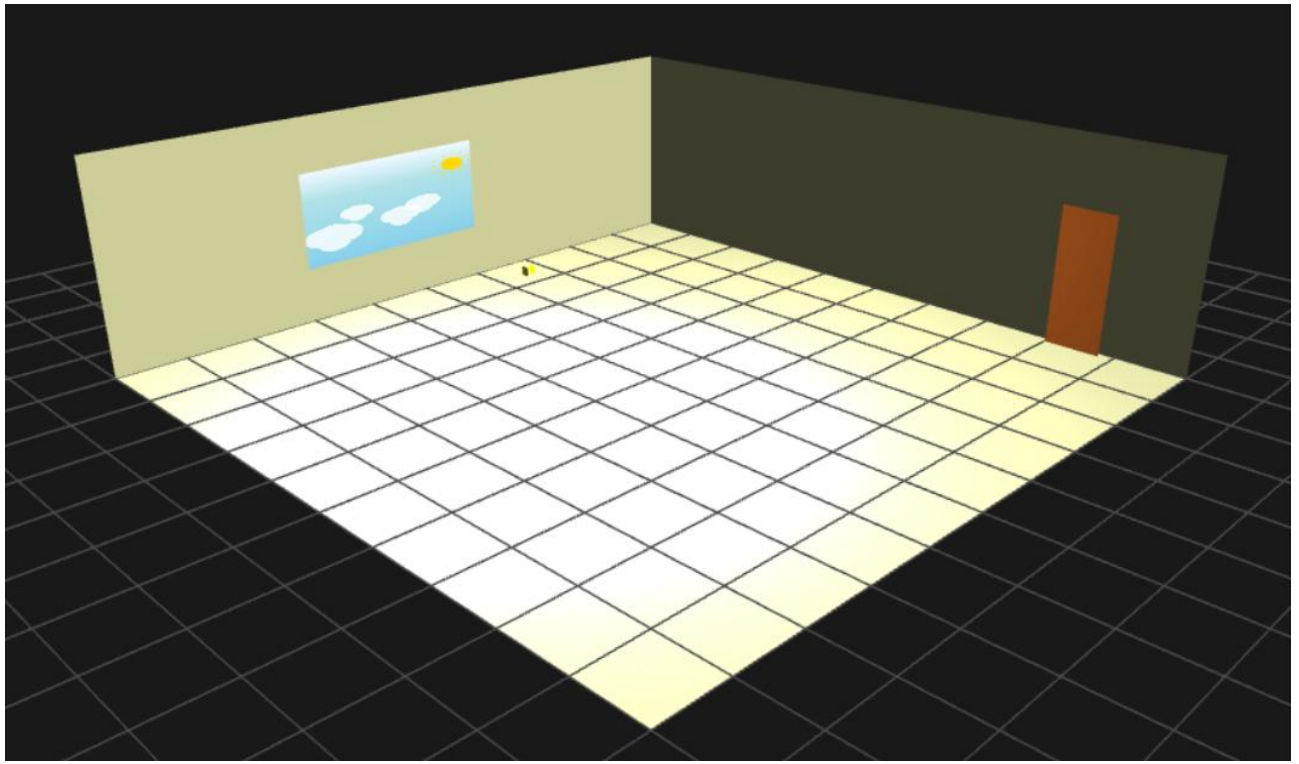
On application start, it loads all necessary components, handles canvas resizing, and binds input events like mouse clicks for object selection.

Rendering Loop

It runs continuously, updating inputs and animations, and re-rendering the scene each frame based on camera view and user interaction.

Scene set-up

- Initialization of the scene with a floor, 4 walls, one dynamic window and a door
- Possibility to change color/texture of both floor and walls
- Configuration of a lighting system including ambient, directional, and point light sources, with visual helpers.
- Grid overlay to help users align and place objects accurately on the floor.



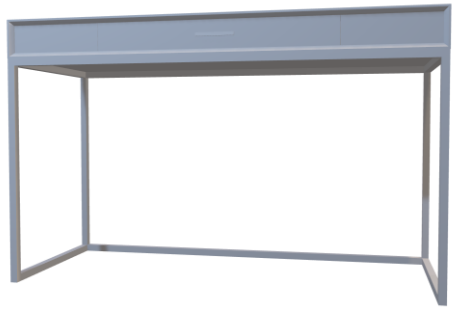
Furniture Management

Bed

Office Chair

Decorations

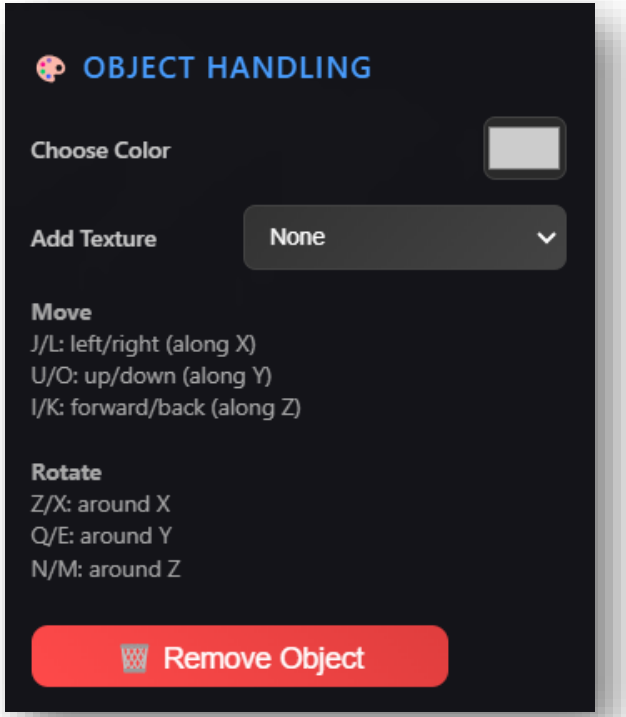
Wardrobe



Desk

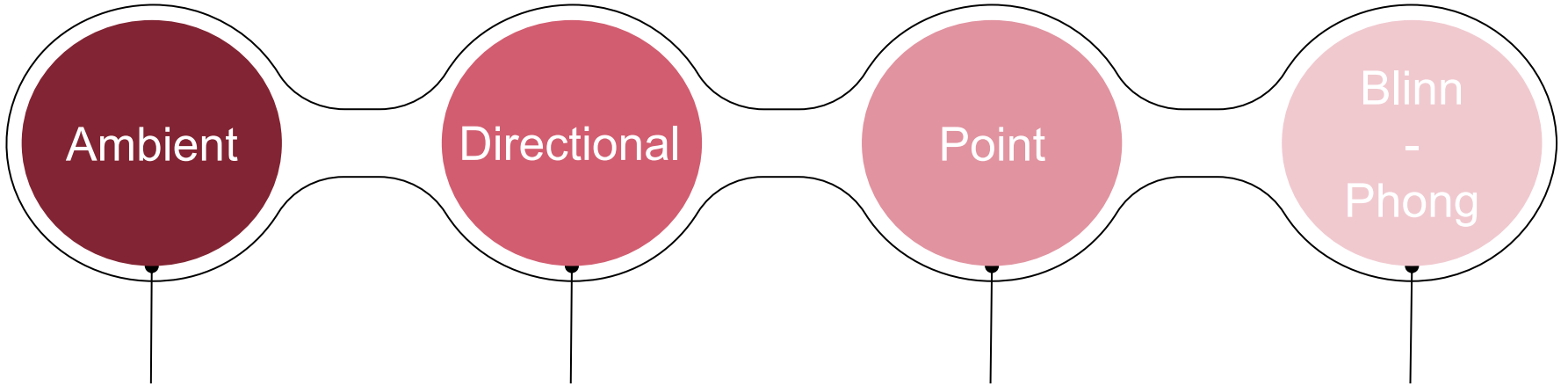
Sofa

Object Handling



- **Selection**: click on any object in the scene to select it.
- **Movement**: move the object along the X, Y, or Z axis
- **Rotation**: rotate the object around any axis
- **Color**: change the material color using the color picker in the UI
- **Texture**: optionally assign a texture image for visual realism
- **Removal**: delete an object using the dedicated button

Lighting System



Addition of a soft, uniform light across the entire scene with adjustable intensity.

It simulates sunlight coming from a fixed direction represented by the window.
Two main modes:

1. **Opened** window: sky shown
2. **Closed** window: shutter texture

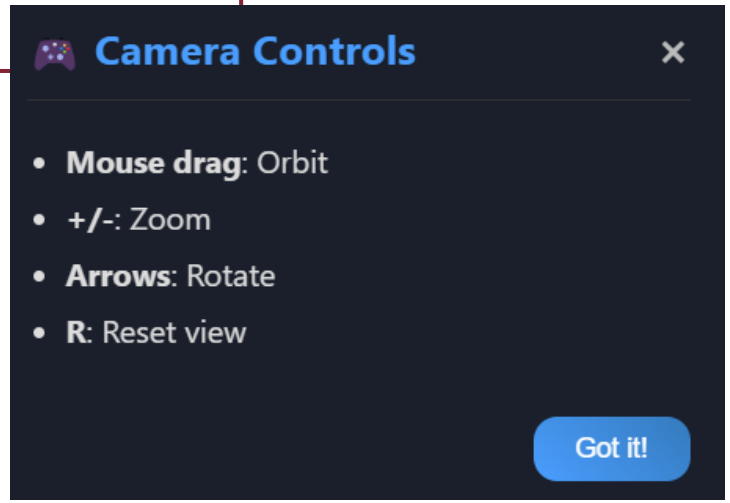
It emits light from a specific position in the room including distance-based attenuation. It's possibile to change its position along the 3 axis and its color too.

It supports diffuse and specular reflection. It allows to regulate shininess level in the room.

Camera System

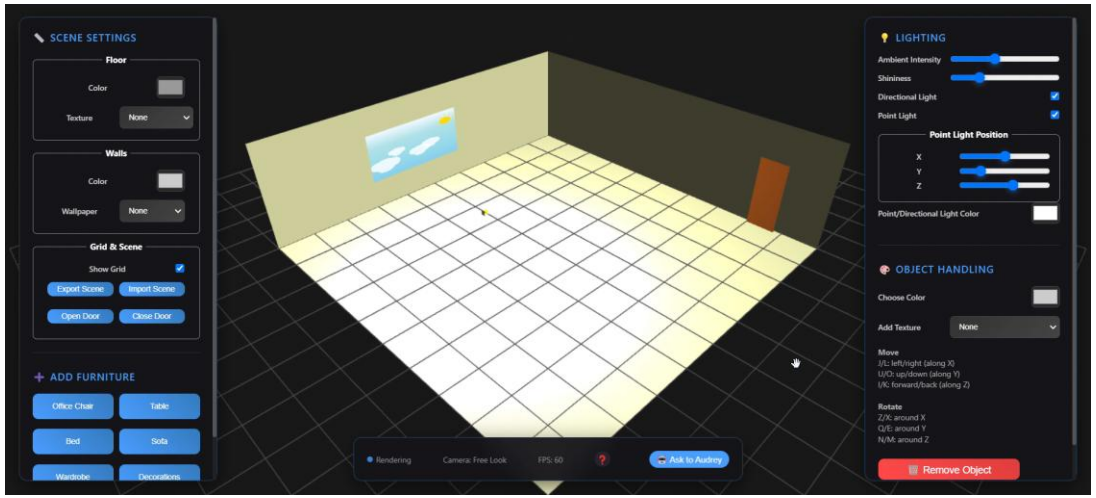
Main Logic

- **Orbiting** camera around a target point with smooth mouse and touch controls.
- **Zoom in/out** using mouse wheel or keyboard (+/-)
- **Reset view** with keyboard shortcut R.
- **Dynamic camera mode indicator** (e.g., “Orbiting”, “Zoom In”) shown in the UI.
- Timeout-based **feedback system** resets to “Free Look” after inactivity.

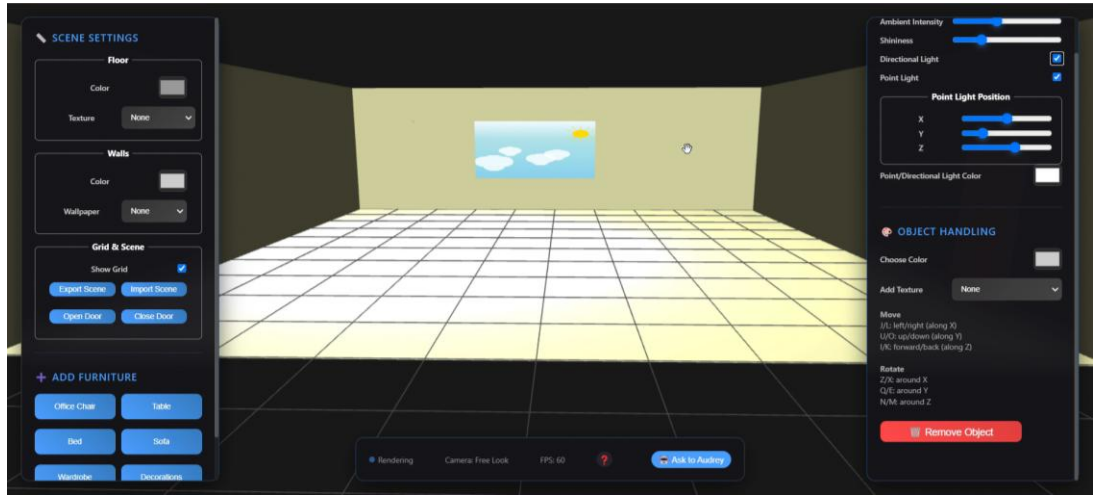


Animations

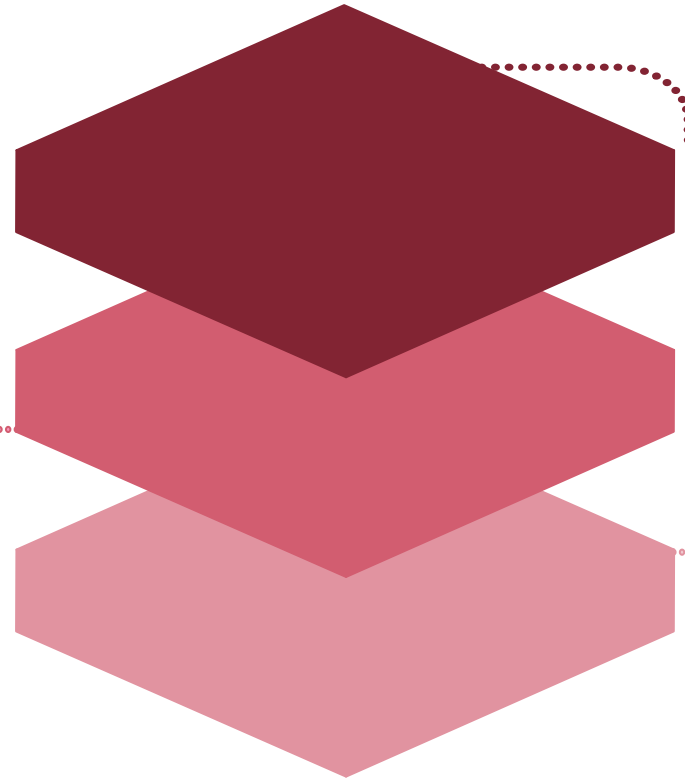
Window



Door



Virtual Assistant



Interactive UI

Chat-based assistant embedded in the WebGL app. It provides clean and responsive design with animations

Design Guidance

Contextual Suggestions for furinture, lighting and color. Use Keyword detection to generate tailored tips.

Quick Actions

One-click buttons to ask to Analyze room, design tips and help. It provides analysis for style and sends proactive tips if idle for 3+ minutes

Audrey currently responds based on a **limited set of predefined replies**. While functional, it does not use real AI or natural language understanding yet. Future improvements aim to make it more dynamic and context-aware.

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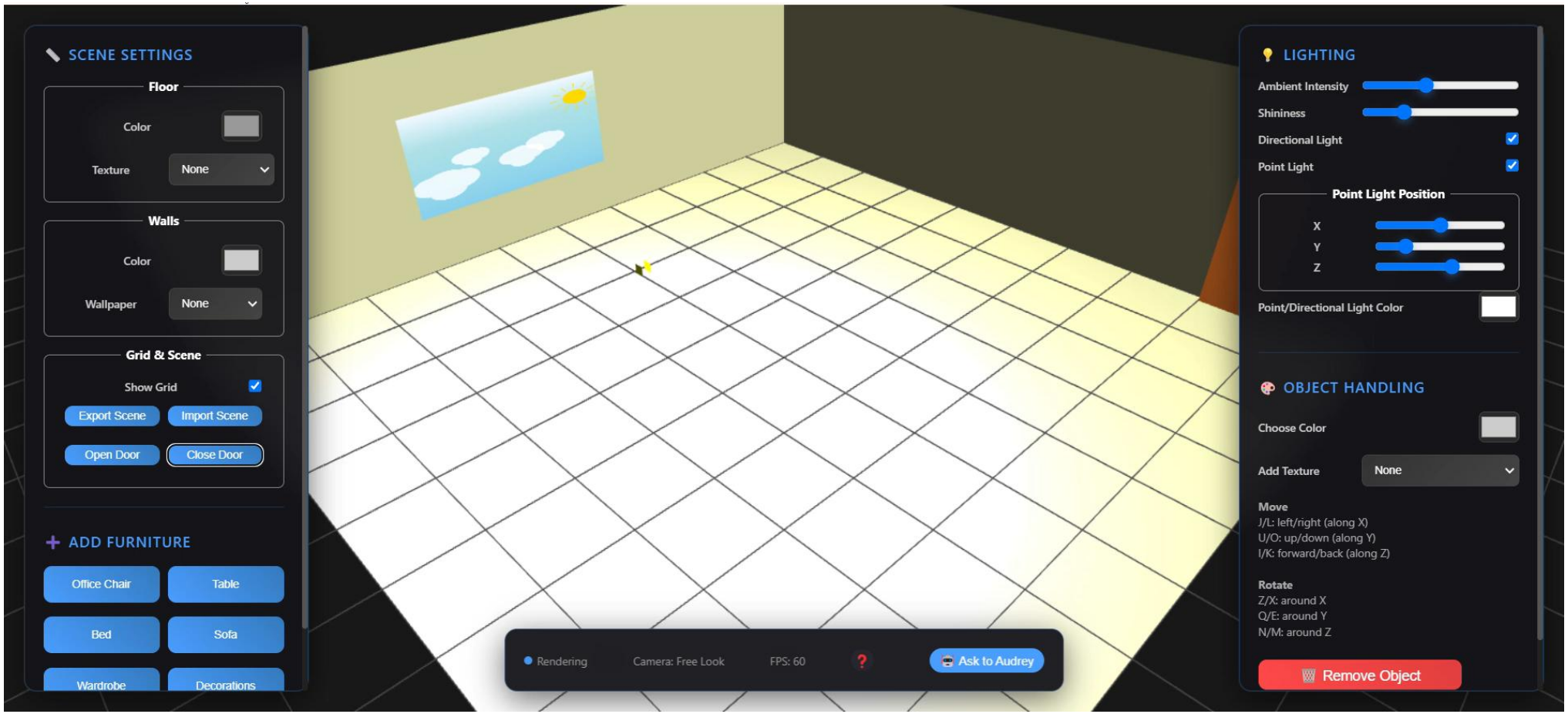
Project Demo •

Live Demo



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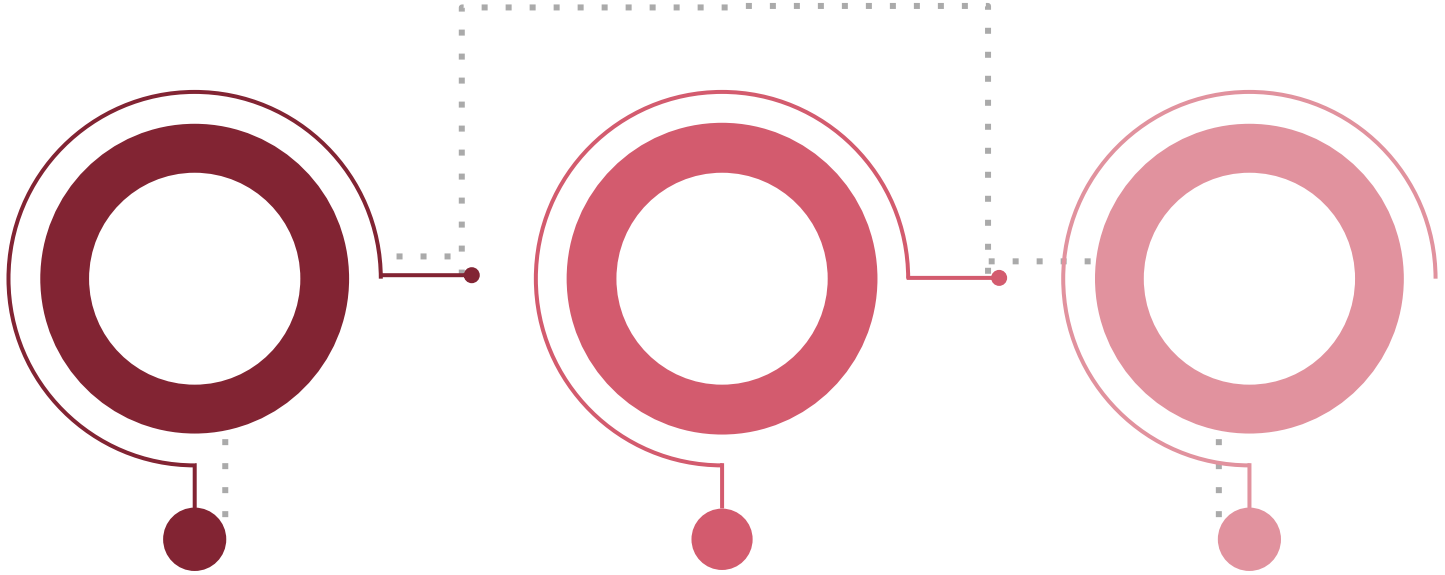
Conclusions and Future Works



RESULTS

Modular WebGL-based room editor built with real-time rendering, object interaction and lighting control

USER-CENTERED

Emphasis on intuitive design through GUI, object manipulation and live customization

FUTURE IMPROVEMENTS

- Expand VA capabilities with NLP and layout reasoning
- Add undo/redo functionality
- Support collaborative editing
- Object Collision check

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References

[1] https://www.fab.com/ to download used 3D Objects

[2] https://github.com/BhaskarAcharjee/3D-Room?tab=readme-ov-file

[3] https://github.com/kodaline/home-planner

[4] https://graphics.cs.utah.edu/courses/cs4600/fall2023/

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Thank you for listening!