VR UE 2024
Tutorial 4: Final Project

Hugo Brument

Soroosh Mortezapoor

Virtual and Augmented Reality Group

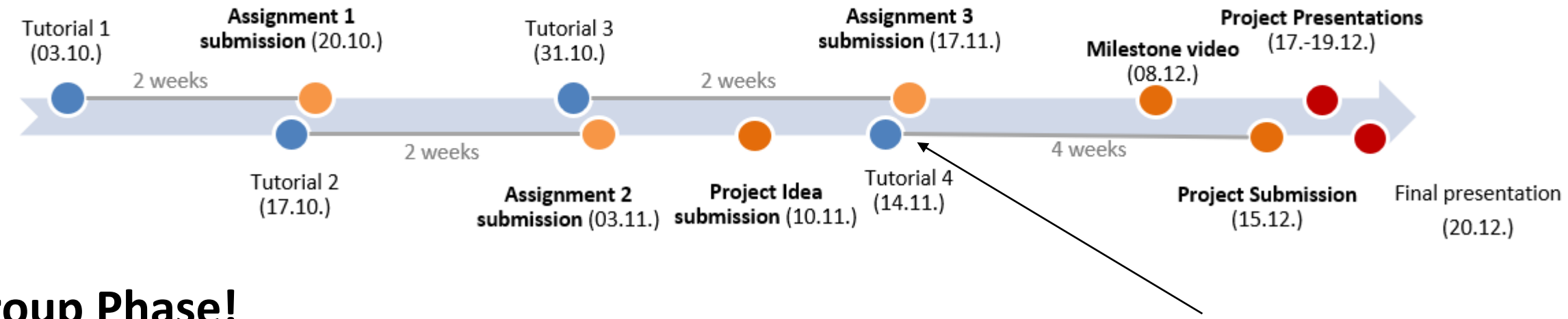
Institute of Visual Computing & Human-Centered Technology

TU Wien, Austria

Agenda

- Organizational
  - Timeline
  - Requirements
  - Evaluation
- Feature list
  - What features are possible

Course Timeline



- **Group Phase!**
- Assignment #3 due on Sunday, the 17th of November
- Submission on TUWEL
  - Submission naming “Group#_Assignment3(_Bonus).zip”
  - .zip of Unity project + build + screenshot **+ <u>description of locomotion</u>**
  - .txt desription of Bonus (optional)
  - Limited to 256 MB (details further on)

VRUE Assignments and Grading

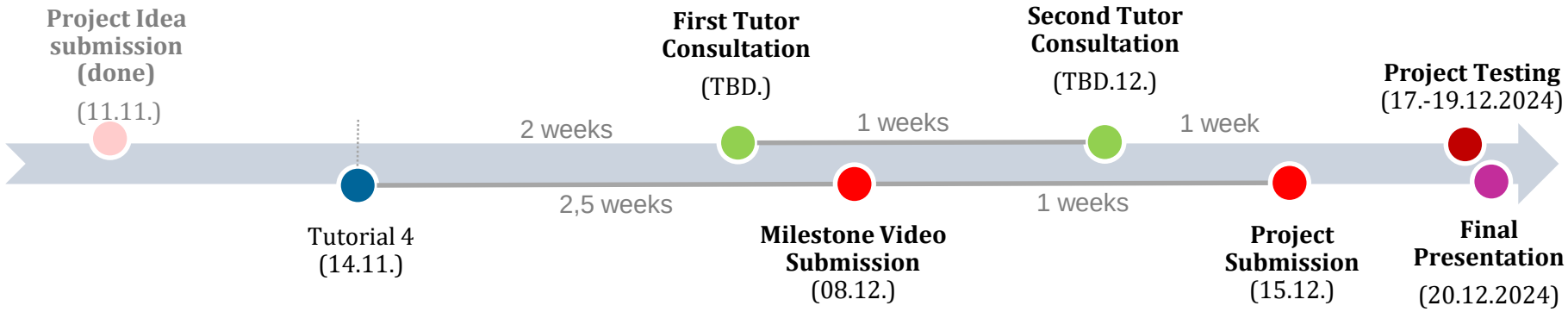
Grading of Assignments (in TUWEL)

Assignment 1	25 points	50%
Assignment 2	25 points	
Assignment 3	25 points	
Project	75 points	50%
Milestone (video)	5 points	
Project submission	70 points	
	150 points total (max.)	

- Grading scale:

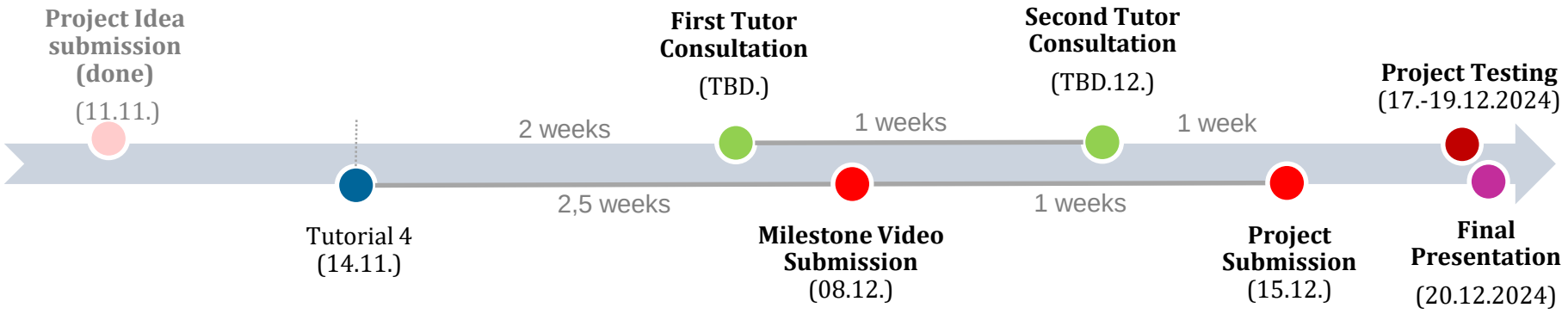
S1 "very good" >= 132 points (88%),
U2 "good" >= 113 points (75%),
B3 "satisfactory" >= 94 points (63%),
G4 "passed" >= 75 points (50%),
N5 "not passed" < 75 points.

Project Timeline



- **Group Project: 4 weeks**
- Two online tutor hours: 1st & 2nd week of December
  - (will be announced on TUWEL)
- Milestone Submission on TUWEL
  - Submission naming “Group#_ProjectName_Milestone.zip”
  - Video (.avi or .mp4) showing the state of the project
  - Extended description of features planned (mark implemented & pending)
  - Limited to 256 MB

Project Timeline



- Final Submission:
  - Complete project + Vive and Quest builds configured with App ID
  - Description of the features implemented
    - Assets list (i.e. credits)
    - Self-implemented
  - 2 min video of the final state
  - Submission via public link (will be announced in TUWEL)

Project assignment

- Implement a small **multi-player**, preferably **collaborative**, **VR application for 2+ players** (2 main actors and others – only observers).
  - Tip: you can test extra players with running an extra build instance.

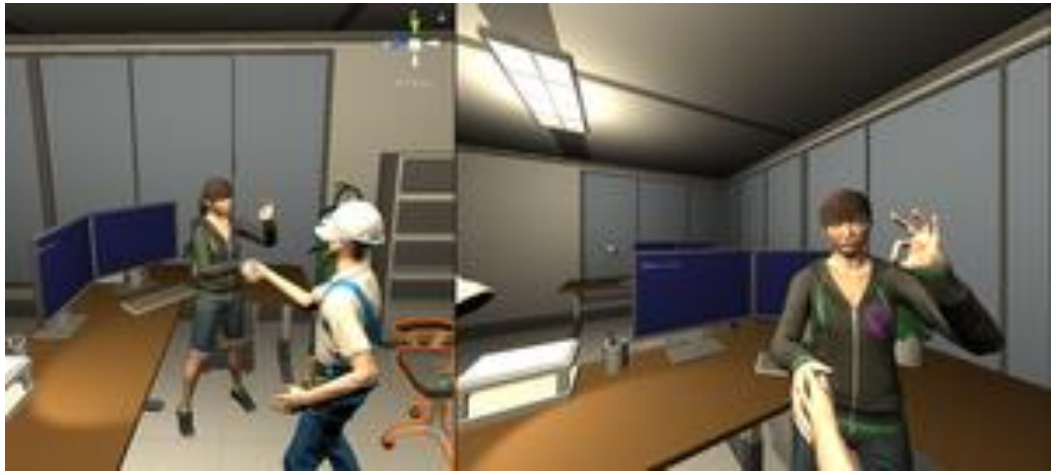
- **It is up to you to define the topic/genre of your application –** it may also be a simulator, educational usecase, or anything else with a purpose. You should aim to design interactions and choose the features that "make sense" for your specific application
  - Be imaginative, could be an escape game, a competitive game, an immersive experience with multimedia, educational content…

Project Requirements

- Obligatory:
  - Multi-user application
  - Users' basic avatars
  - Terrain+Skybox/Environment
  - Proper Lightning
  - Basic UI (connect, disconnect, restart, exit)
  - Clean Networking
  - Project/Scene organization
  - Choose features to implement (see next slide)

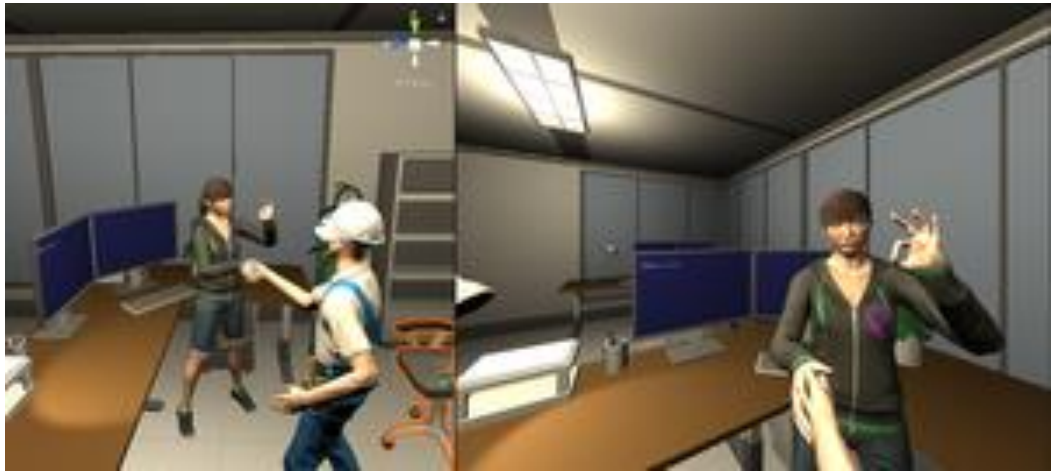
Mandatory Requirements

- Multi User
  - Support 2+ users. The application task or scenario can be limited to two users. The other users will have to be “ghost” observers (with limited functionality, e.g. with ability to navigate, but not interact, semi-transparent avatars). On disconnection of the main user, one of the observers might get that role (optional).



Mandatory Requirements

- Users‘ avatars
  - Each user should have an avatar: some sort of a networked representation of a head and hands, torso is optional.
    - Can use primitives or existing models
    - Ready Player Me for advanced avatar features https://readyplayer.me/developers



Mandatory Requirements

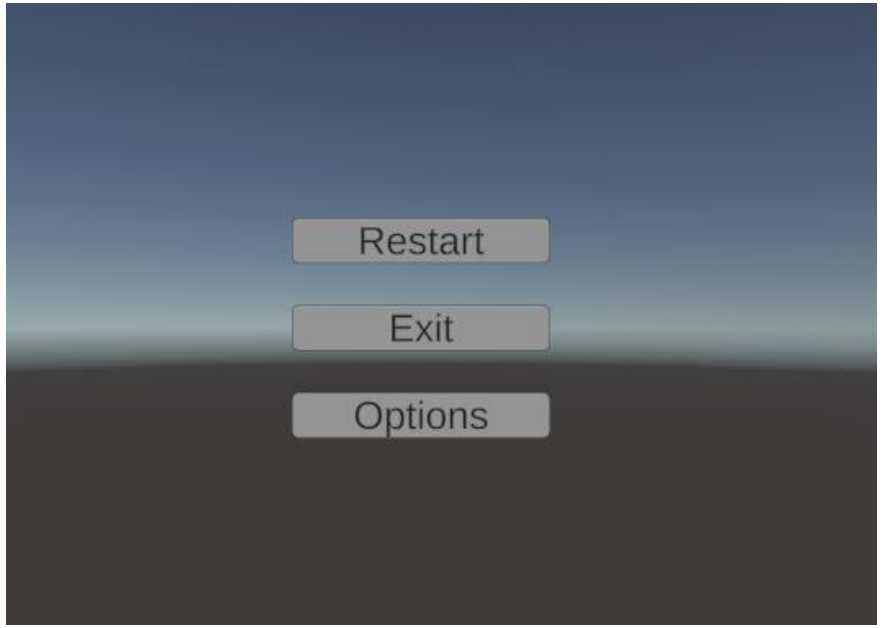
- Environment: Skybox,Terrain/Indoor scene/Water surface
  - The surroundings of the users should be represented with a complete and properly designed environment: no visible “end of the world” (unless required by concept) and other blank spaces.
    - Open world with terrain
    - Escape room with closed buildings/scenes

Mandatory Requirements

- Lighting
  - The scene and all objects in it should be properly lit and visible, unless otherwise required by the concept.

Mandatory Requirements

- Basic UI
  - Provide the users with a basic UI and enable them to: reset, and exit the application, control the general volume of the application. Feel free to add extra features if wanted.
    - Canvas Screen or Camera space – overlay when a button is pressed



Mandatory Requirements

- Project and File structures
  - Scenes should be in the folder Assets -> Scenes
  - Scripts should be in the folder Assets -> Scripts
  - Custom prefabs should be in the folder Assets -> Resources -> Prefabs
  - Custom materials should be in the folder Assets -> Resources -> Materials
  - Custom models (.fbx, .obj) should be in the folder Assets -> Resources -> Models
  - Custom multimedia files should be in the folder Assets -> Resources -> Multimedia_*, where * is the type of media (image, sound, video, animation, others...)
  - External assets from Unity Asset Store and alike Assets -> External

Mandatory Requirements

- Project and File structures
  - Make sure that:
    - you are using the correct Unity version (2021.3.44f1 LTS);
    - your hierarchy and project files are well organized;
    - every script serves a dedicated purpose and can be reused in the future with minimal changes;
    - your scripts are attached to the game objects they are most related to;
    - all builds are really working – test them!

Free Choice Features

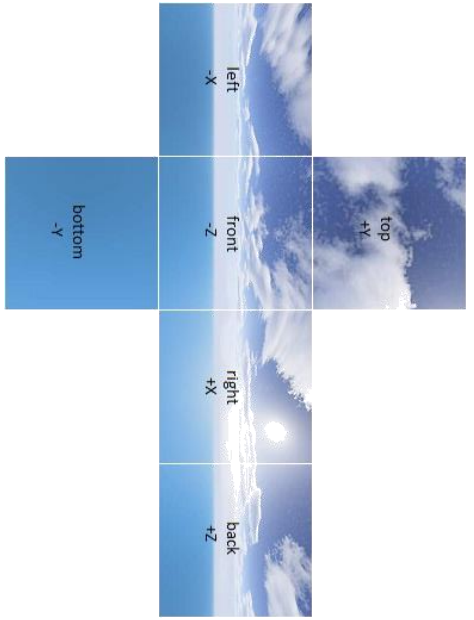
- Each feature has a weight associated with it
  - Ranging from 0,5 to 3
  - If the feature's weight is set as a range – you can clarify the final value after the Milestone submission
- Preliminary weight estimation can be done on the following criteria:
  - Difficulty of application
  - Variety of application cases
  - Additional code needed
  - Difference from defaults
  - Creativity of application

Complex & Self-Implemented features are valued the most

- **The goal** is to have the cumulative weight of all features **equal 3 or more**

World builder tweaks: Skybox

- **Skybox: Texture to render the background environment**
  - check asset store for a variety of free skyboxes
  - https://docs.unity3d.com/Manual/LightingOverview.html
  - Unity advanced tutorials
    - https://learn.unity.com/project/working-with-lighting-in-unity
    - https://learn.unity.com/tutorial/configuring-lightmaps



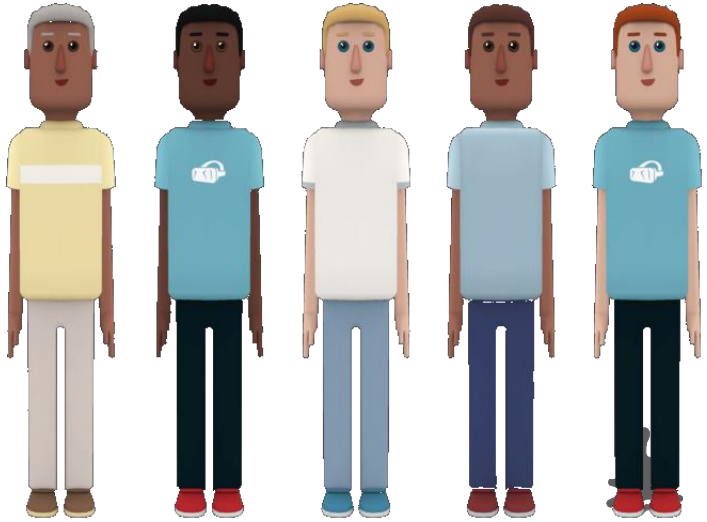
World-Builder Features

- Change skybox & light parameters with UI
  - At least 3 different adjustments
  - Weight: 1
- Create & modify objects with UI
  - At least 3 different objects
  - Weight: 1
- Group operations with objects
  - At least 3 different operations
  - Weight: 1

https://youtu.be/OX1hSQwnngo

Avatar Features

- Customize VR avatar runtime: choose hand, leg, hair...
  - Weight: 2
- Adjust VR avatar to manually adjust to the user (rescale individual body parts)
  - Weight: 2-3, ready assets like Unity Multipurpose Avatar (UMA)=2
    - https://assetstore.unity.com/packages/3d/characters/uma-2-unity-multipurpose-avatar-35611
  - Or use Ready player me avatars
    - https://readyplayer.me/blog/getting-started-with-ready-player-me-integration-in-unity
    - https://www.youtube.com/watch?v=tfpIXlGor2E&list=PLSq-rVcJ9fMb1vKqRdsgRCjNcddxxPmVU&index=4
- Hand tracking with Leap Motion or Oculus hand tracking
  - Weight: 2
- Hand-controller animation beyond standard buttons
  - Weight: 1
- Inventory System
  - Weight: 0.5



Navigation

1. **Navigation within the tracking area – inherent for VR setup**
   Allows *natural walking* within each user's tracking area.
   To enable interaction between users, you need to make sure that their tracking areas overlap/coincide, so that they can reach each other. (Position of tracking space within the virtual world is defined by the position of the Rig.)

2. **Navigation beyond the tracking area - feature**
   A "distant travel technique" allows all users to jointly move to another area of the virtual world, which lies beyond their current tracking area (e.g., mount a vehicle to travel somewhere further away and dismount again to walk around).
   Once they have arrived at the new location, they should again be able to walk around (see point 1). (Reposition tracking space by moving origin of Rig.)

Locomotion Features

- Locomotion metaphor with a helper object
  - Car, scooter, magic carpet...
  - Moving parts should be moving somehow
  - Weight: 2
- Locomotion metaphor without a helper
  - Bound to movement, should not match assignment 3
  - flying, climbing, jumping teleportation etc.
  - Weight: 1-2
- Teleportation
  - Weight: 0.5

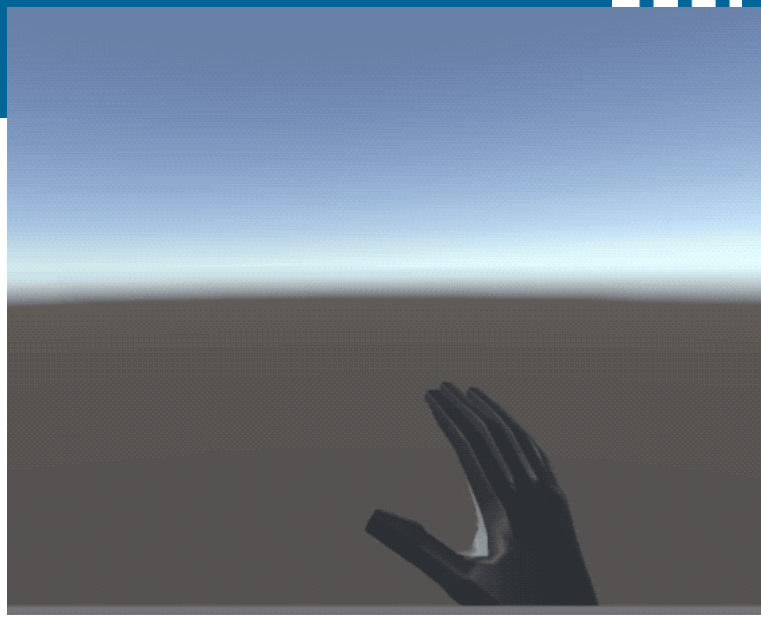
Example: Distant Travel Technique

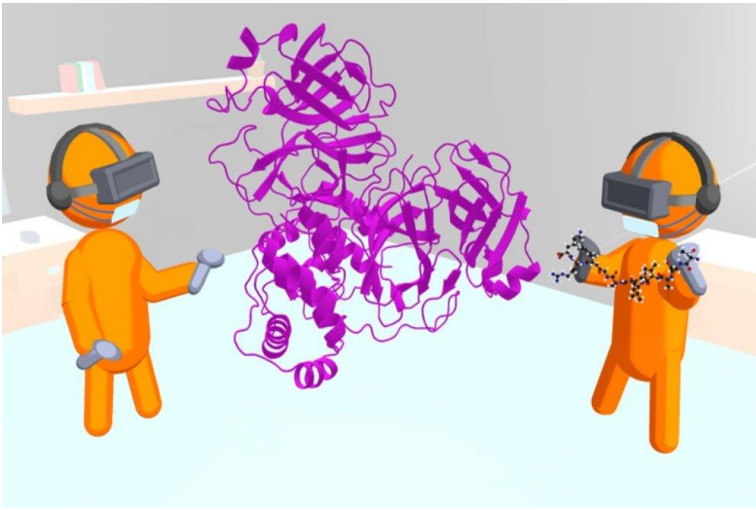
Example: Distant Travel Technique

Communication Features

- Voice chat with PUN voice
  - Weight: 1.5
- Text chat between users with PUN chat
  - Simplified UI is fine, e.g. text like on a mobile
  - Weight: 2
- Sign exchange for communication
  - Like smiles
  - Weight: 1

Interaction Features

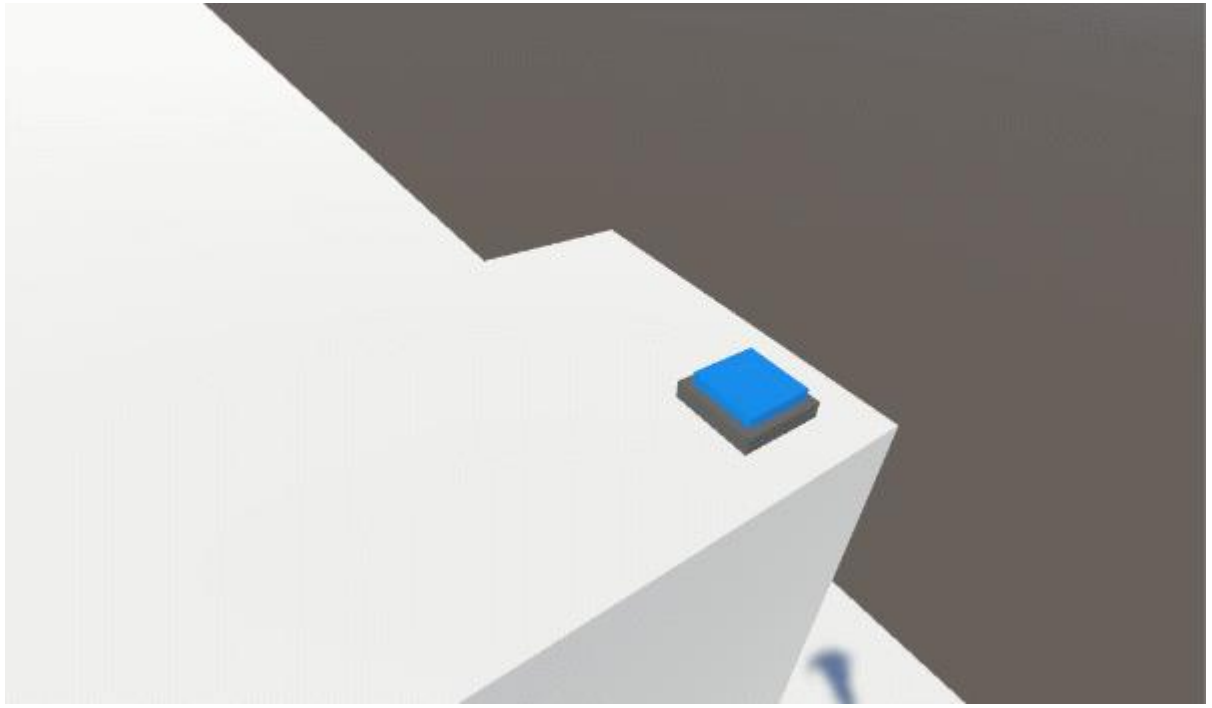




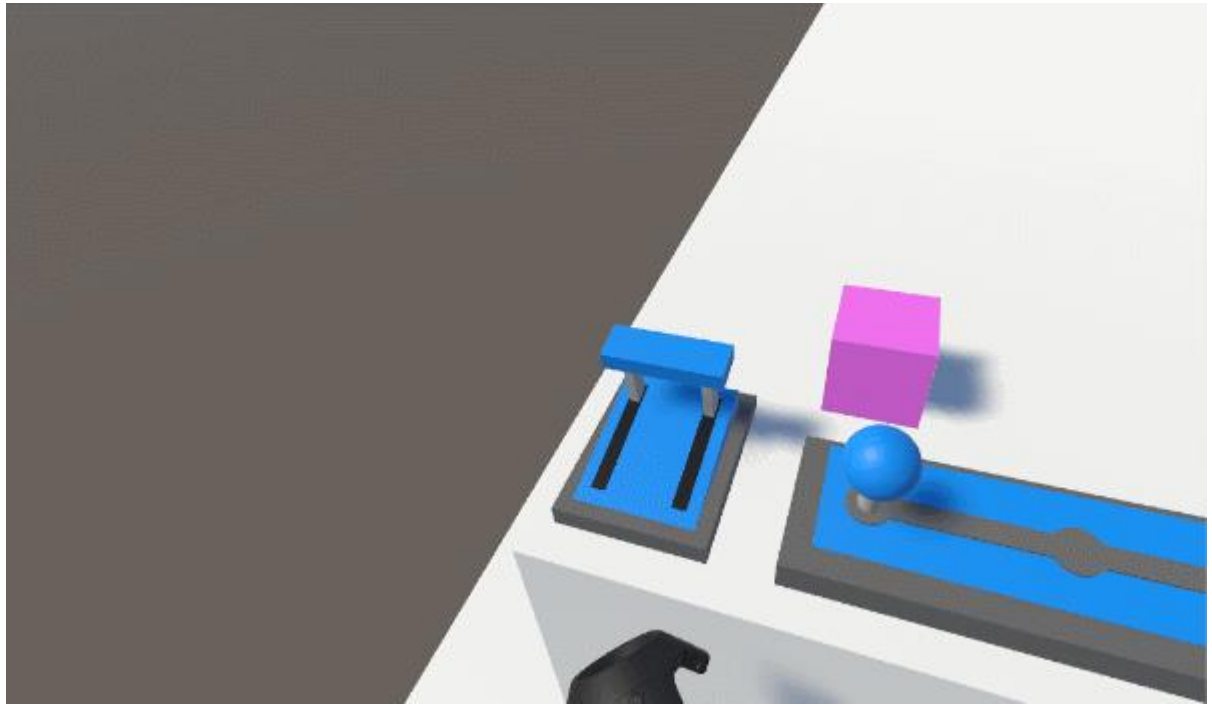
- Gesture recognition with hands or controllers
  - Minimum 3 gestures
  - Weight: 2
- Haptics with real tracked object with a vive tracker
  - Weight: 2
- Complex interaction
  - Weight: two-handed = 1, multi-component/multi-tool = 2
- Networked object(s) that can be passed hand to hand
  - A falling object should fall correctly for all users
  - Weight: 1
- 2-Player simultaneous collaborative interaction with world
  - Weight: 1

Example: Good Interaction

Not good: Pulling the trigger on the controller makes the button move down.

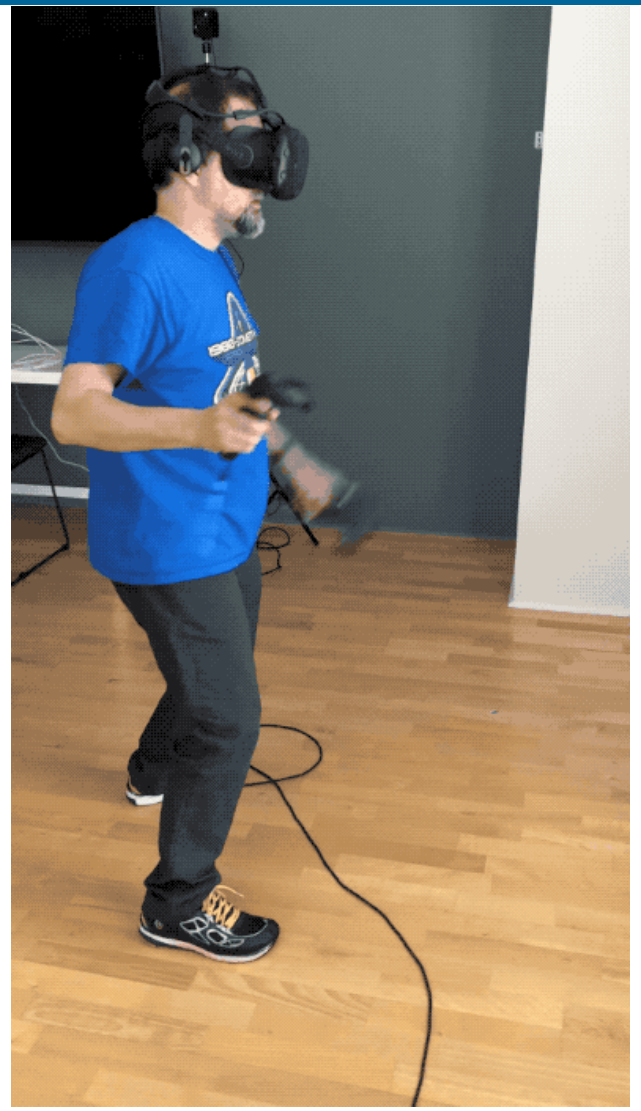


Good alternative: “Pushing” down with the controller makes the button move down. (Use of colliders/rigidbodies, movement,…)



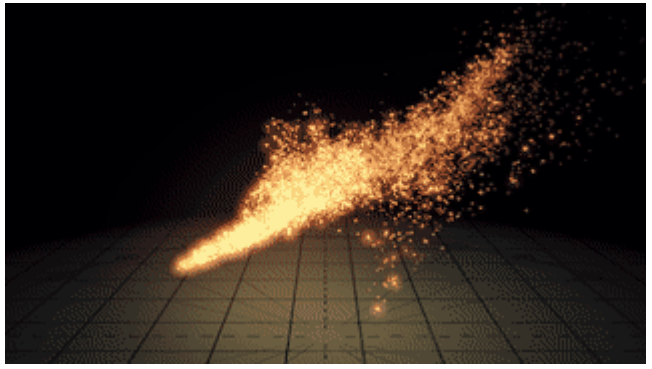
Good: Pulling the trigger on the controller to grab the lever AND then moving the controller to push the lever down.

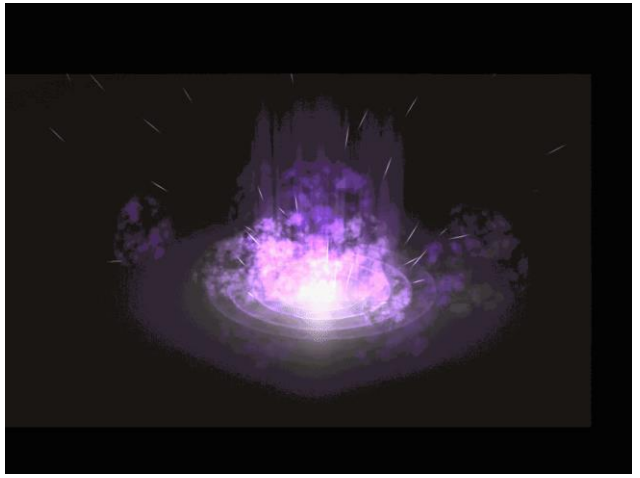
Example: GOOD Controller Interaction



Effects Features

- Particle systems
  (https://docs.unity3d.com/Manual/ParticleSystems.html)
  - Simulates and renders many small images or Meshes, called particles, to produce a visual effect
  - Use for moving liquids, smoke, clouds, flames, magic spells, etc.
  - Weight: 0.5

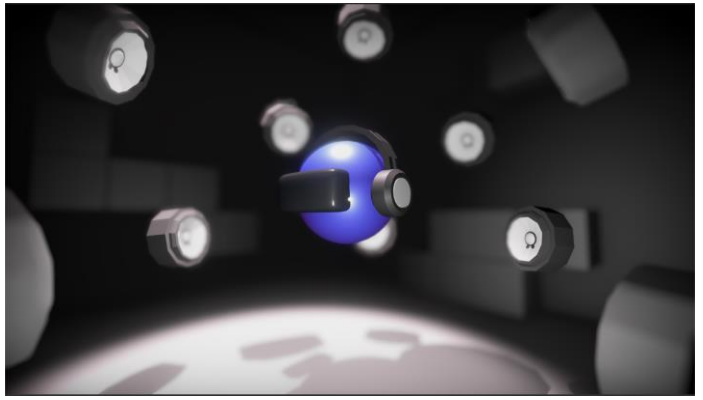




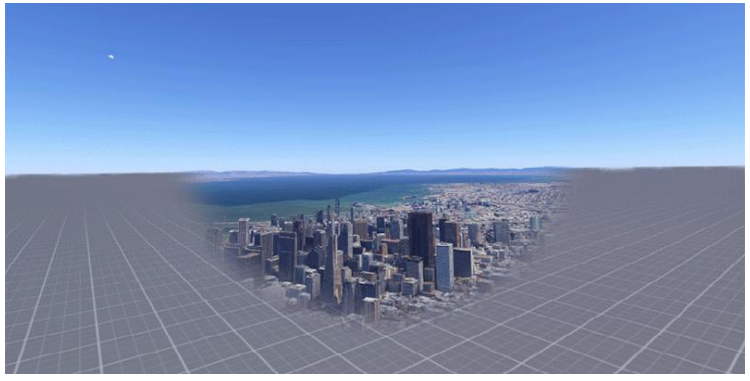
Effects Features

- Spatial audio
  - Unity Manual https://docs.unity3d.com/Manual/Audio.html
  - Unity Audio Core Tutorial https://learn.unity.com/project/creative-core-audio
  - Audio Mixer allows you to mix various audio sources, apply effects to them, and perform mastering.
  - Weight: background+ a couple of sound effects = 0.5, more complex system with multiple sounds in 3D space = 1

https://docs.unity3d.com/Manual/AudioOverview.html

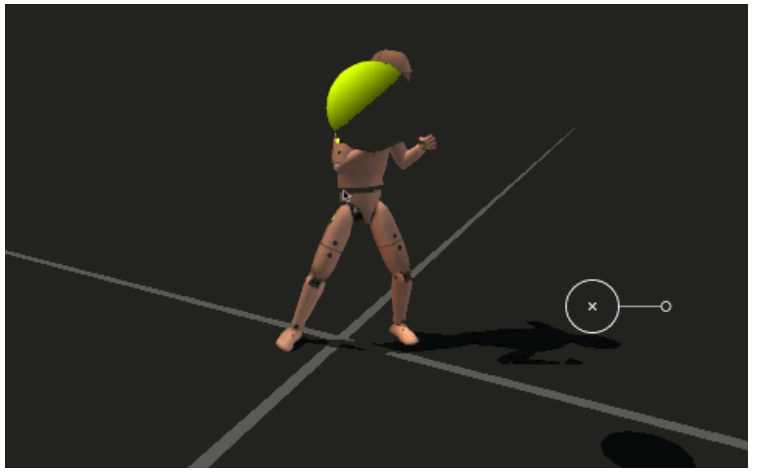


- Haptics with vibrations
  - Weight: notifications = 0.5, more complex like material simulation etc. = 1
- Camera manipulations
  - Enable manipulation of a FOV, camera pose manipulations, spectator view for observers
  - Weight: 0.5



Effects Features

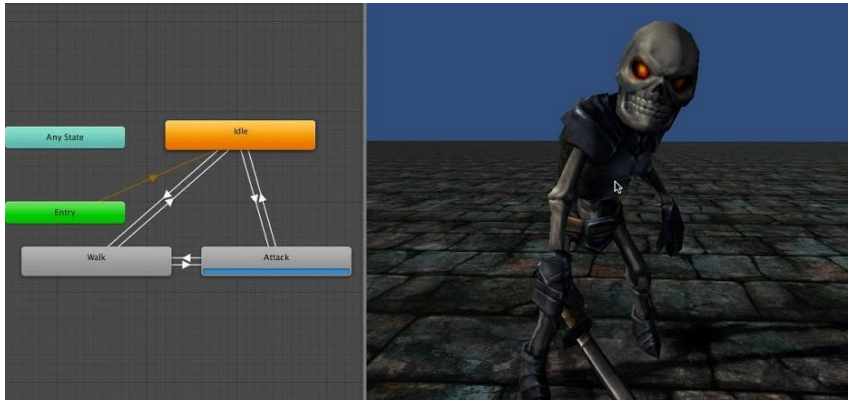
- Mini-map of the virtual environment
  - Should show your current location in VE
  - Weight: 0.5
    - Can be done with RenderTexture applied on camera
- Complex physics (more than use of the Rigidbodies)
  - Might include: interaction, simulation or advanced character physics (e.g. puppet)
  - Weight: 1-2



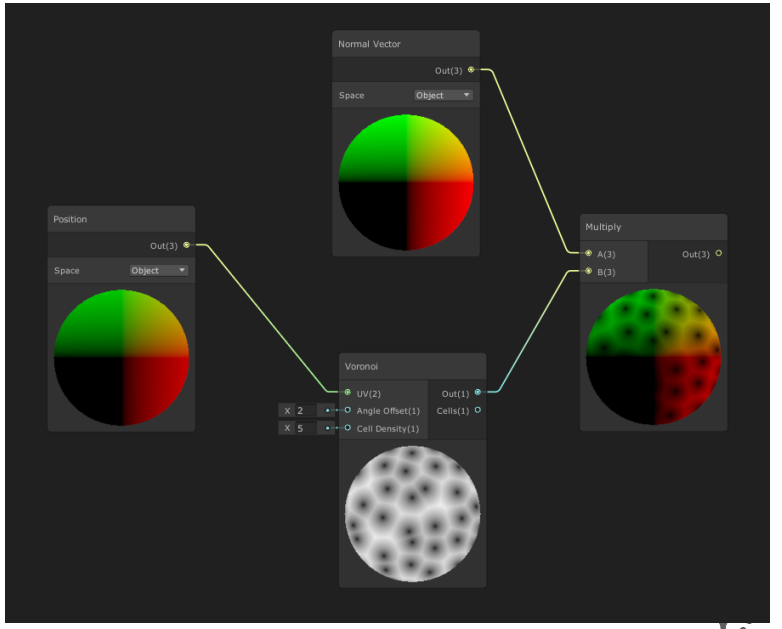
http://unity3d.com/learn/tutorials/topics/animation

Effects Features

- Objects or NPCs animation https://docs.unity.cn/2020.3/Documentation/Manual/AnimationSection.html
  - Create or use existing animations, react to events within environment to trigger or alter animation, call events from within the animation playback, use transitions between animations, etc.
  - Weight: applying an existing animation, trigger it and stop without artifacts = 1, add smooth transitions between animations = 2



- Custom shaders
  - small scripts that contain the mathematical calculations and algorithms for calculating the color of each pixel rendered, based on the lighting and Material
  - Graphical coding is possible with shader graph https://on.unity.com/36inVnp
  - Weight: 1



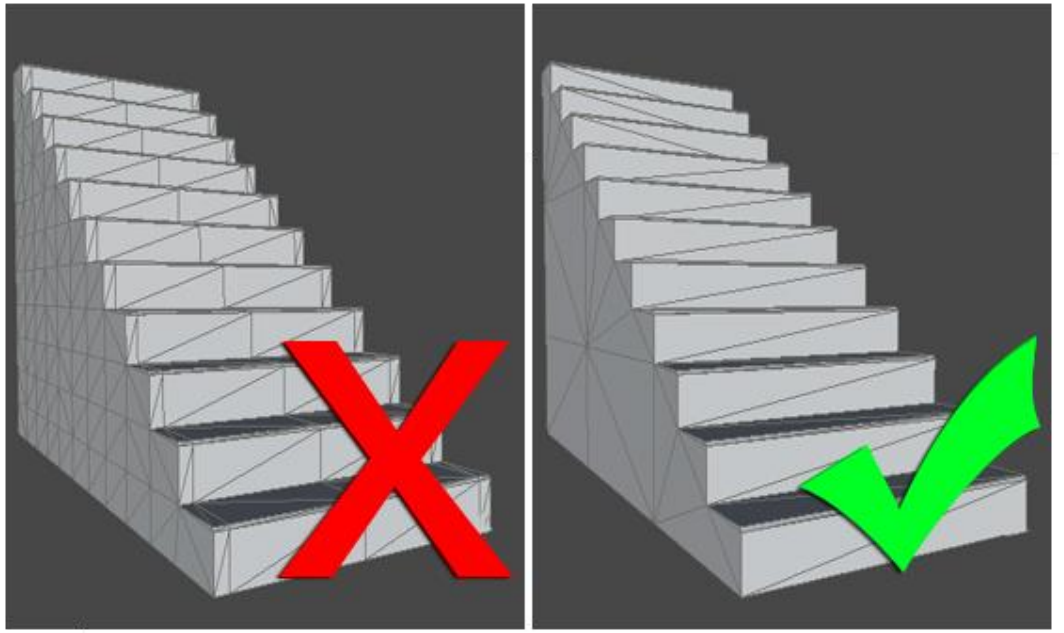
Grading

- Milestone submission – 5pts
- Obligatory features implemented - 10pts
- Free choice features: each weight point = 15pts
  - Total: 45pts
- Qualitative criteria for feature points
  - Implementation – 5pts
  - Visuals – 5pts
  - Quality of interaction – 5pts

- Total project worth: 75 pts

Best Practices

- Use models with low polygon count to save processing power
- Avoid using many large textures
  - Instead, make textures as small as possible (lower resolution)
  - Consider tiling textures
- Make sure to remove imported assets that are no longer used!



Best Practices

- Always keep comfort in mind
  - Maintain at least 90fps
  - Consider content visibility (account for screen differences in Quest and Vive)
  - Limit unintended interactions
  - No movement should take place unless it’s user-driven
  - Be consistent with metrics
  - Employ Virtual Safety Goggles – attempts to protect one’s eyes from flying objects might lead to an injury
- If something looks interactive, it has to be interactive
  - You need to take into account that people are not necessarily going to interact with the environment in the way you expect

Best Practices

- Think multi-platform from day 1
- Always think about your performance targets
  - Do not get carried away just to discover that your application is way too slow on Quest because of the assets you chose
  - Readapting your project is counterproductive
- Choose the right features for your idea
  - The blueprints and assumptions you have based on traditional game design often do not work in the same way when it comes to VR
- **Don't underestimate testing!!!**

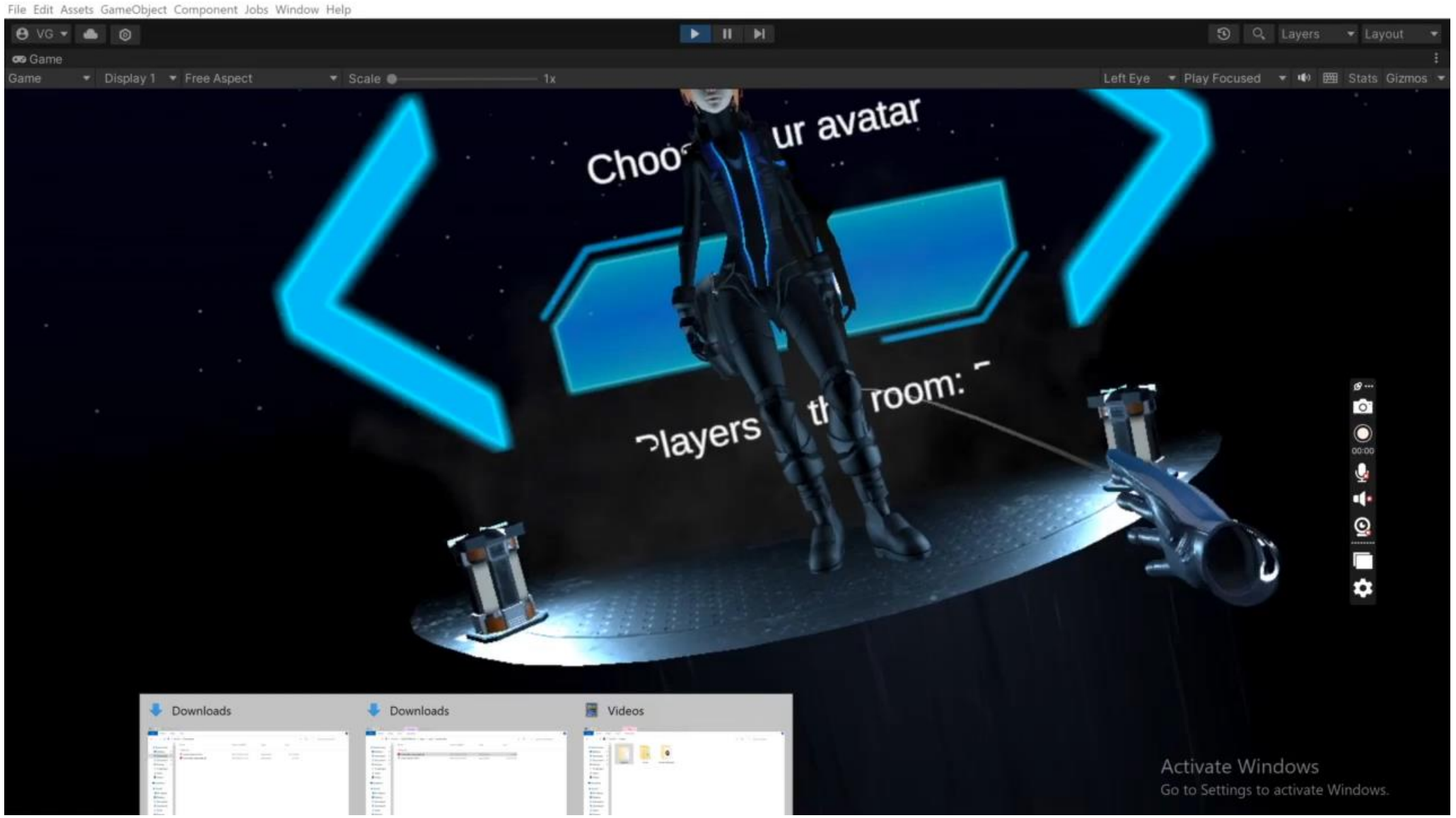
VR Contest

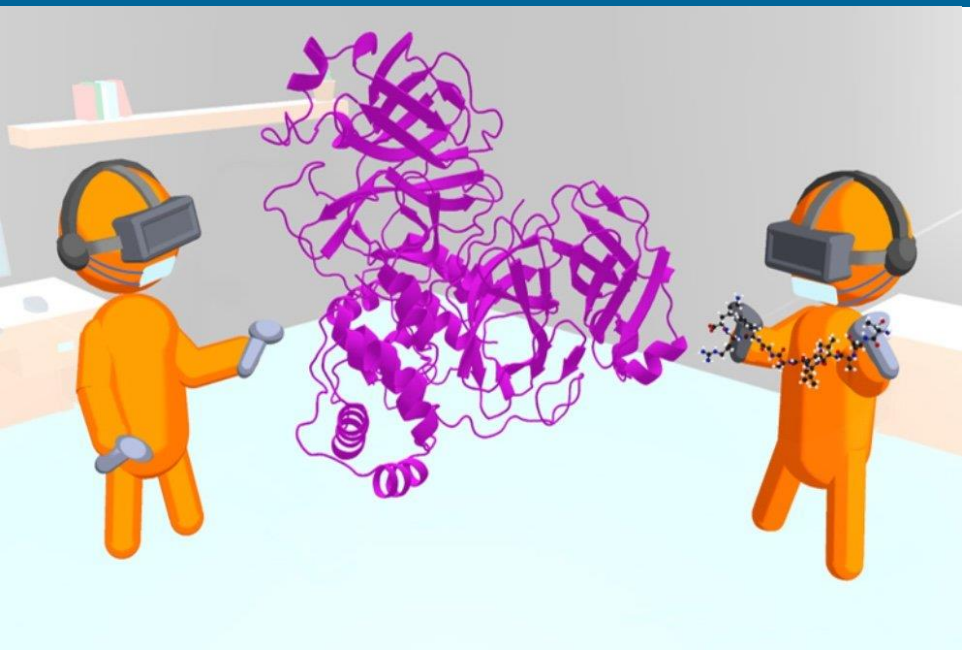
- Best projects will be selected:
  - By the VRUE-team
    - Focus: technical features
  - Course participants
    - Vote held in TUWEL

Best Gameplay VRUE 23 – The Last Camp

Best Implementation VRUE 23 – Basebasher

Audience award VRUE 23 – Light me up





Thank you for your attention.
Questions?