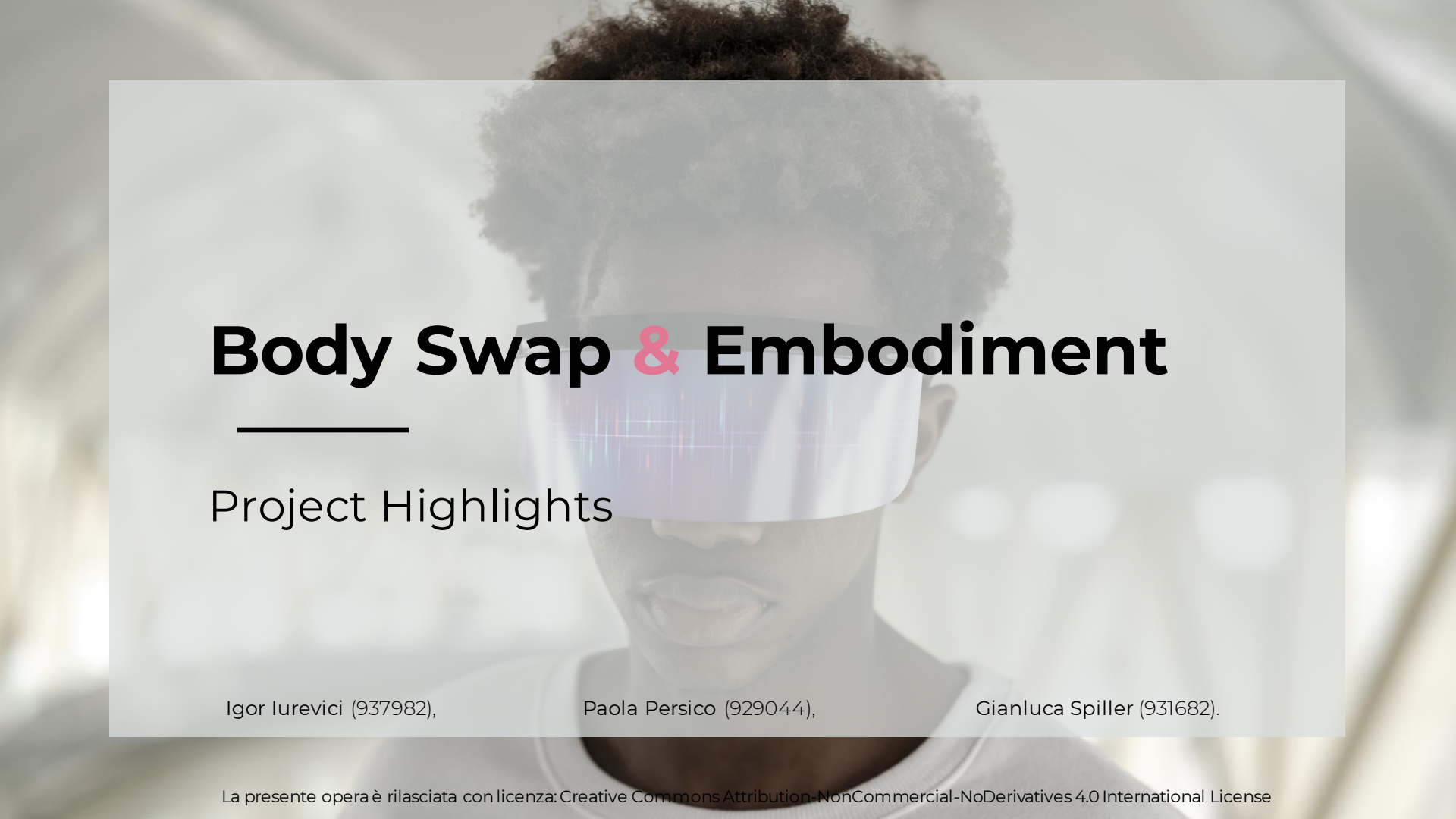


Body Swap & Embodiment

Project Highlights

Igor Iurevici (937982), Paola Persico (929044), Gianluca Spiller (931682).

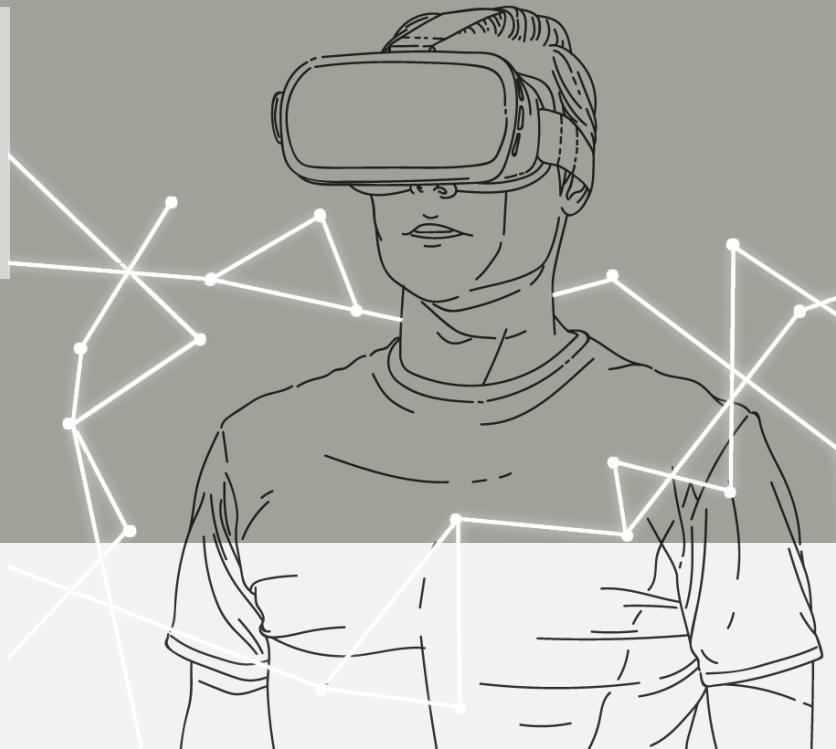
Overview

Embodiment experience in a female avatar, inside a virtual environment created to represent an hostile crowd.

Prototype of **Body Swap** through the use of 3d scans of real people by leveraging on VR multiplayer.

Body Swap through the use of streaming **webcam** mounted on HMD headsets.

Embodiment



Technologies

Software

- Unity3D
- OpenXR
- SteamVR
- XR Interaction Toolkit

Hardware

- HTC Vive
- HTC Vive Pro
- Alienware Desktop PC
  - CPU Intel Core i7-6850k
  - 32GB di RAM
  - 2x GPU Nvidia GTX 1080

Avatar

Modelling : MakeHuman

Rigging : Mixamo

Inverse Kinematics

Head	Hands
o Goal: Camera	o Goal: Controller
o Animation Rigging	o Mecanim
o Multi Parent Constraint	o OnAnimatorIK()
o Map()	

Rotation of the upper body based on the angle with the arms

Avatar

Room-Scale VR

Navigation

- Headset velocity
- Blending of animations
  - Walk
  - Walk Backwards
  - Right Turn
  - Left Turn

Crouching

- Raycast from feet
  - Contact point with floor
  - Mecanim
- Raycast from head
  - Contact point with floor
  - Correction of upper body

Collisions

- Prediction through a copy
  - Capsule Collider on upper body and hands
  - Rigidbody Kinematic on hands
- Sospension of alignment

Virtual Agents

Models

- **MakeHuman**
  - Modelling rigging
  - MHX2
- **Blender**
  - Blendshapes creation
  - FBX
- **Unity**
  - Shader correction

GameObjects of virtual agents in Unity.

Virtual Agents

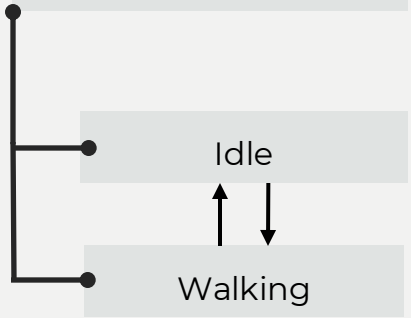
Animation

- **Viso**

  Morph target animation

- **Corpo**

  Unity AssetStore



Agenti with walking animation.

Virtual Agents

Controller

- **NavMesh**

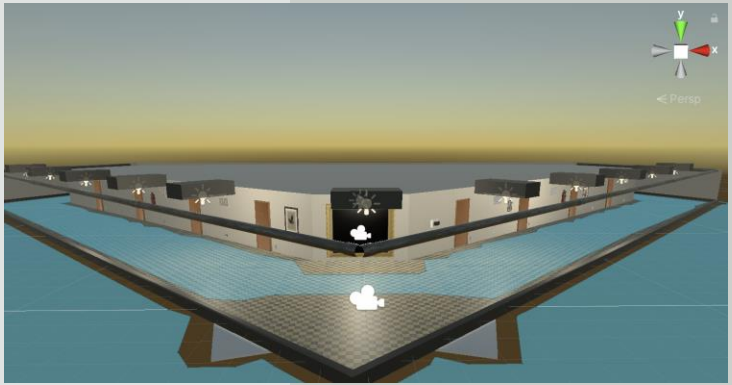
  Pseudorandom movement in a prefixed area

- **Velocity**

  Walking and lip movement with dynamic velocity

- **Phases**

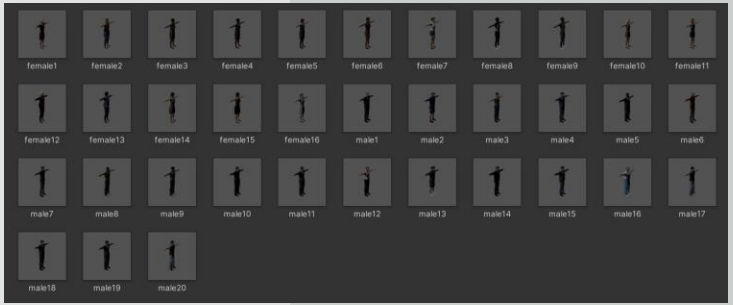
Active agents	Passive agents
○ Walking	○ Walking
○ Looking at avatar	.
○ Moving lips	.
○ Encicle	.
○ Heading back	.
	○ Heading back



NavMesh area inside the environment.

Virtual Agents

Spawner



List of Prefabs

Iteration List<GameObject> of 36 agents Prefabs

Delay (5s)

Counter increase

Instantiate number of Prefab determined by counter

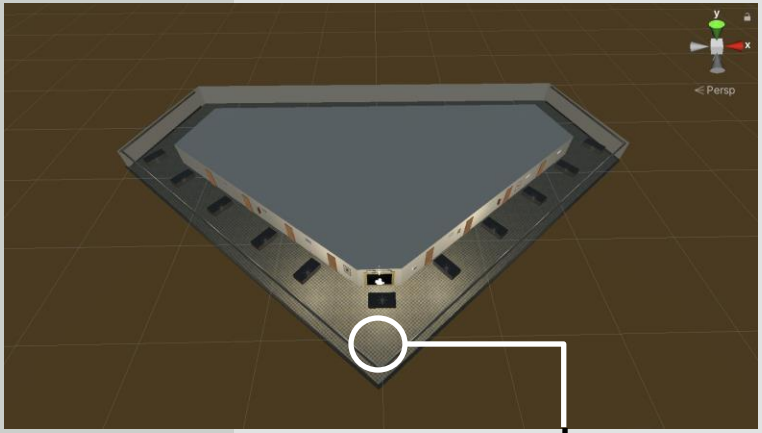
Environment

” Inevitable end of corridor ”

Liminal Space

- Estethics of a physical space
- Transition between two states
- Sensation of anxiety and nostalgia
- **Examples**: corridor, waiting room, parking lot

Environment



Final environment

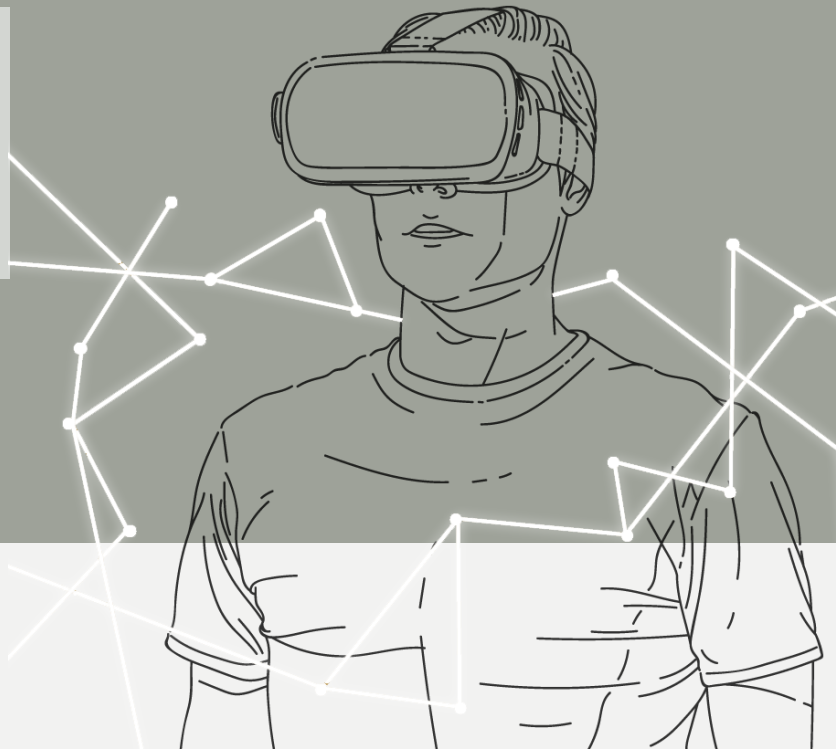
Ambiente Virtuale

- **Liminal Space**
- **Corridor** of a penthagonal hotel
- Model built with **ProBuilder**
- **Mirror** with camera to simulate reflection:
  - Dynamic FoV
- Models importated from Unity Asset Store

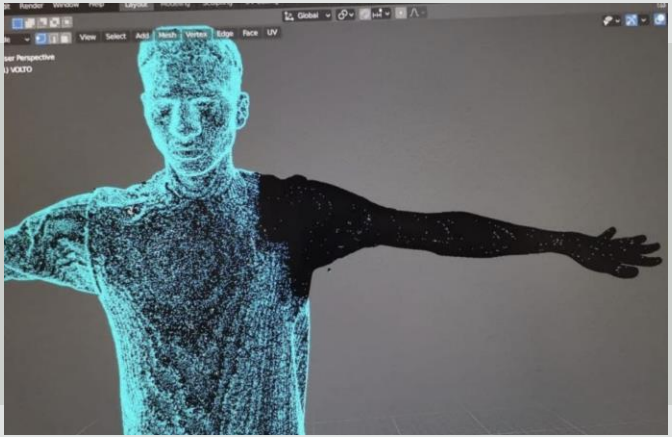
Other features

- **Interface**
  - Static canvas
  - Button to start the experience
- **Avatar calibration**
  - Head height
  - Arm length: $\frac{Altezza\ testa}{2} - lunghezza\ della\ mano$
- **Optimization**
  - Occlusion culling
  - Static GameObjects
  - GPU instancing of repeated materials

Body Swap



Multiplayer



Artec Eva 3D Scanner

3D scanning of the two subjects

Blender

- Polygons decimation
- Axes alignment
- Holes filling
- Normal correction

Photoshop

Texture paint

3DCoat

Vertex Paint

Mixamo

Rigging of models

Unity

Shader correction

Multiplayer

- Photon Pun 2
- Interface
  - Canvas with two buttons
- Data sync
  - Photon View
  - Photon Transform View
  - Photon Animator View
- Remote Inverse Kinematics

photon
UNITY NETWORKING

Webcam streaming

Wired ✓

Pros

- **High resolution**
- **Low latency**

Cons

- Freedom of movement limited by cable length

✗ Wireless

Pros

- More freedom of movement

Cons

- Low resolution
- High latency

Webcam streaming

VS

Logitech C920

Zed Mini

Webcam streaming

Logitech C920

Pros

- Low cost
- Accessible

Cons

- Diffucult sync
- Ad-hoc support required
- Cumbersome cabling

Zed Mini

Pros

- Single cable for a single device
- SDK included
- Support for HMD

Cons

- High cost
- Libraries have to be modified

Future work

- **More optimixation**
  - Combination of skinned mesh renderer
  - Implementation of anti-aliasing ad-hoc techniques
- **Full Body Tracking**

  To get info about leg movement
- **Testing**
  - User testing to analyse Presence e Motion Sickness
  - Neuropsychological Testing
- **Background sound**

Conclusion

The developed prototypes have been successfully able to guarantee the desired VR experience of embodiment in a different body.

External images credits: Freepik.com

Thank you