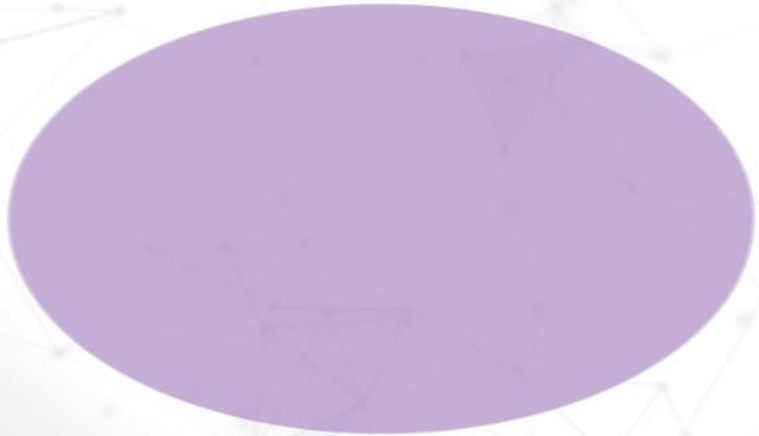
MIXIOR LABS

TU Delft

IEEE AIVR 2020
ImAna workshop



Aalto University

Technische Universität Braunschweig

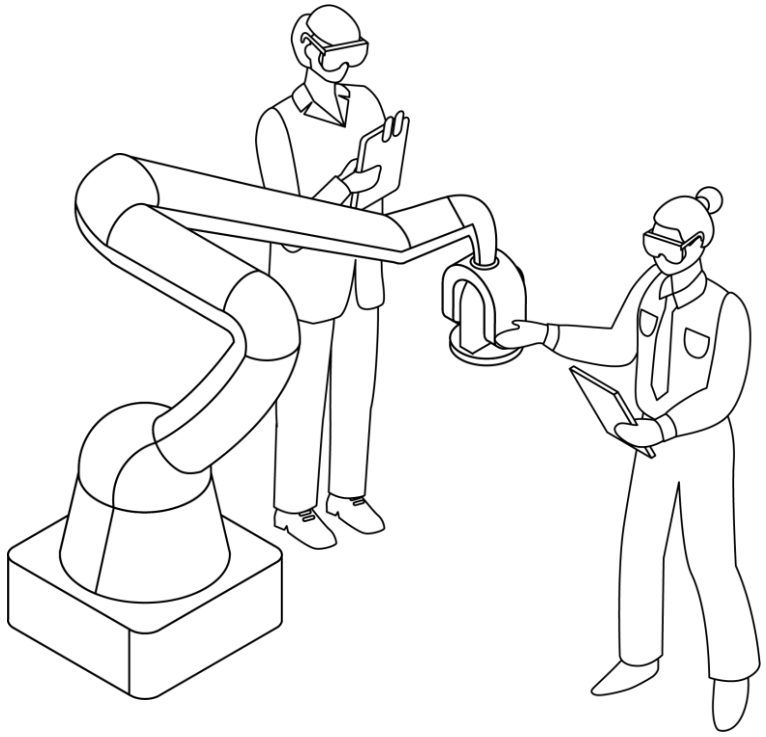
SUPSI

LMS
Laboratory for Manufacturing Systems & Automation

INESCTEC

eit

TU Delft



MirrorLab Core Partner

The partners

TU Delft (NL)

TU Braunschweig (DE)

Tartu (EE)

LMS (GR)

SUPSI (IT)

Aalto (FI)

INESC TEC (PT)

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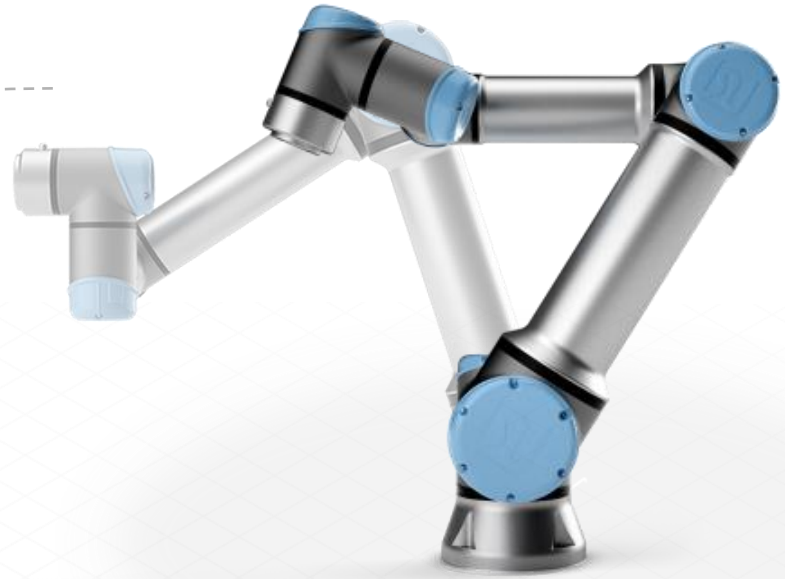
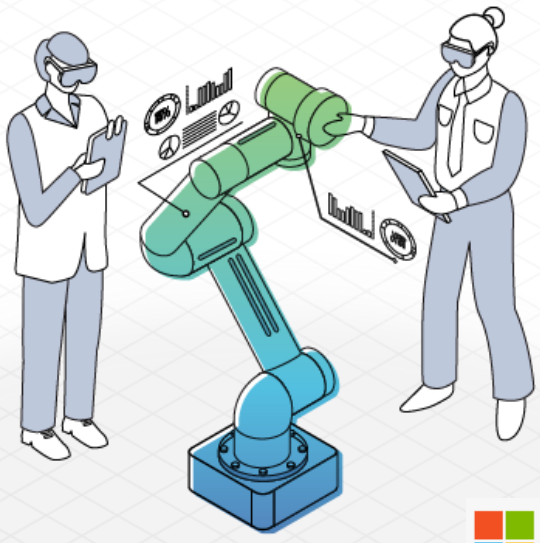
Research assistant



MirrorLabs

Real UR5

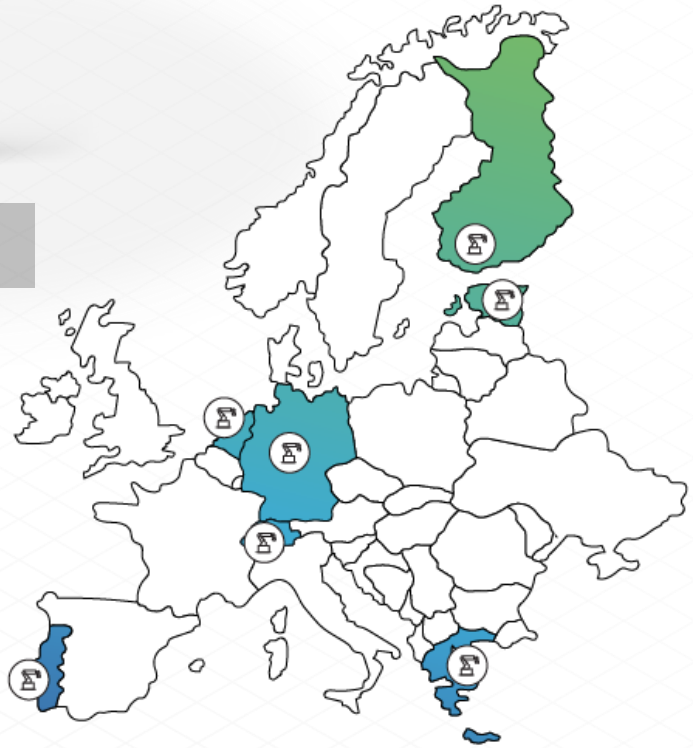
ROS



Virtual Robot

Microsoft HoloLens

unity

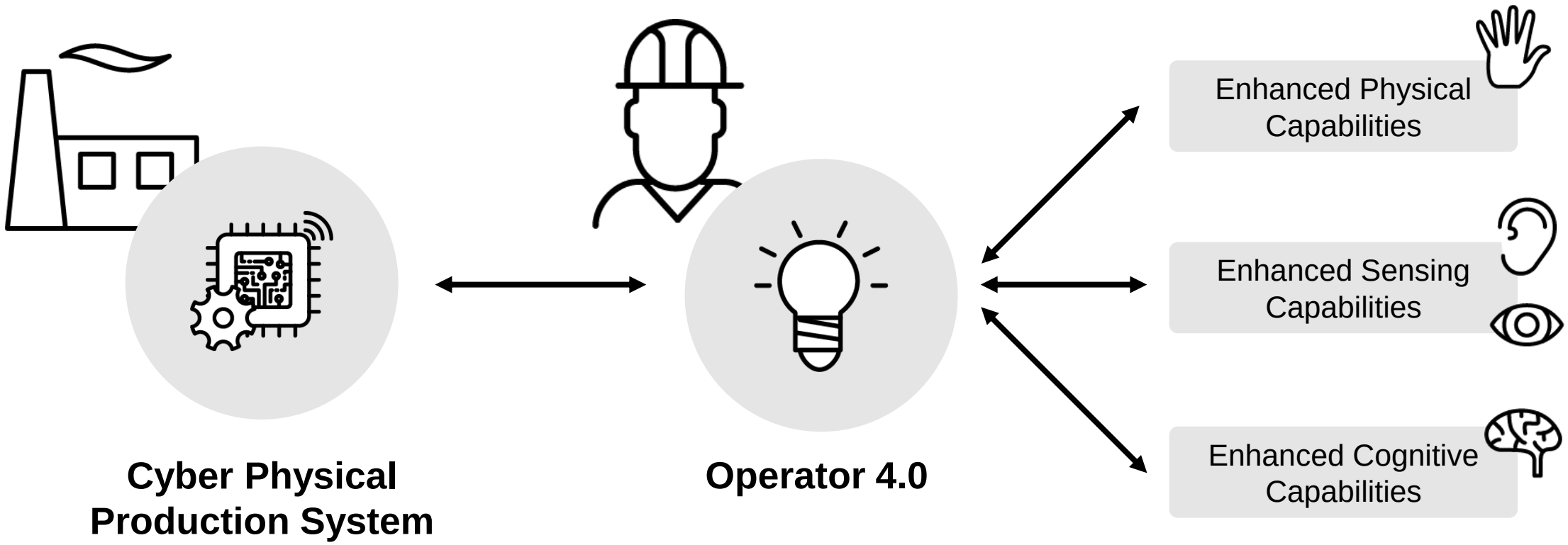


Socio-technological Change

- **Technological change:**
  - Industrie 4.0 (Germany)
  - Smart Manufacturing (USA)
  - Next-generation manufacturing (China)
- **Social (demographic) change:**
  - Aging society
  - Migration

⇨ We need the “Operator 4.0“

Operator 4.0

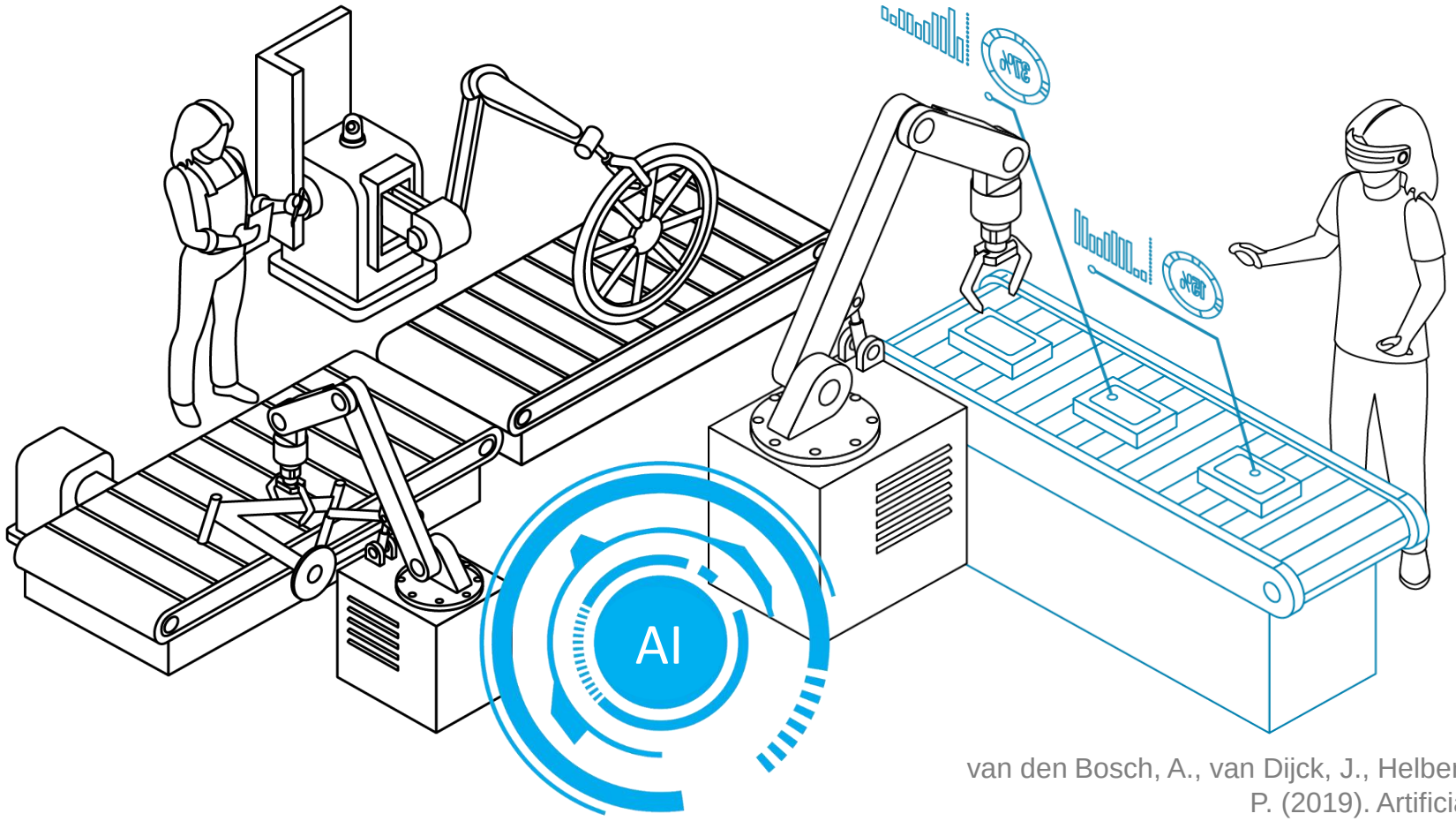


Romero, D., Bernus, P., Noran, O., Stahre, J., Fast-Berglund, Å. 2016. The Operator 4.0: Human Cyber-Physical Systems & Adaptive Automation towards Human-Automation Symbiosis Work Systems. Production Management Initiatives for a Sustainable World. Springer.

RQ-1. How can humans and AI systems productively interact and understand each other's behaviour in context?

RQ-2. How can we realise AI systems that deserve human trust?

RQ-3. How can we design tasks for hybrid human and AI teams?



van den Bosch, A., van Dijck, J., Helberger, N., Heylen, D., Hindriks, K., Hoos, H. & Vossen, P. (2019). Artificial Intelligence Research Agenda for the Netherlands.

Supported infrastructure

Robots:

- UR10
- UR5
- UR3
- Franka Emika Panda
- MiR100
- support other ROS-enabled robots with MoveIt step by step

Software:

- ROS complemented by Melodic
- Unity version 2019.4 for AR/VR
- Main platform is Ubuntu
- shared via the TU Delft project git: https://git.tu-delft.ne-kloud.de/ (link on the website)

Devices (AR and VR):

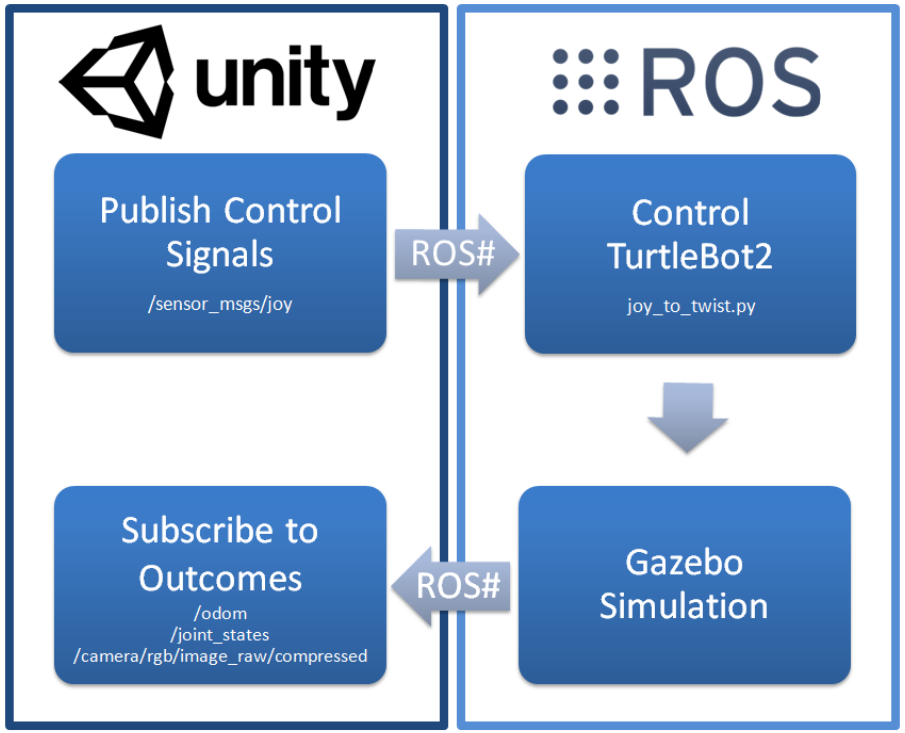
- Microsoft HoloLens v1
- Microsoft HoloLens v2
- HTC Vive
- Oculus Quest + Rift

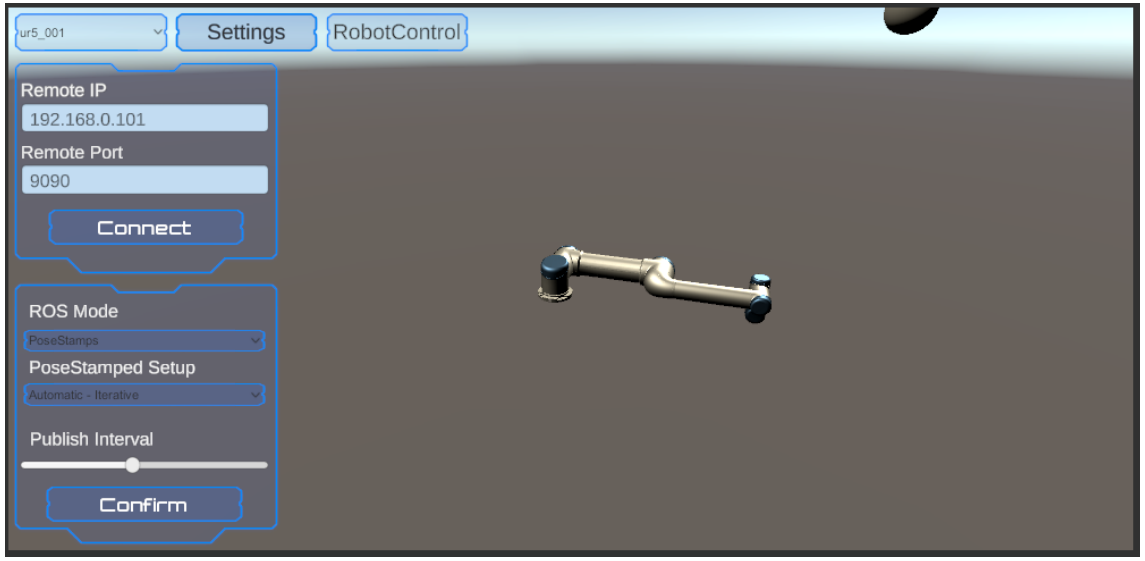
Sensors:

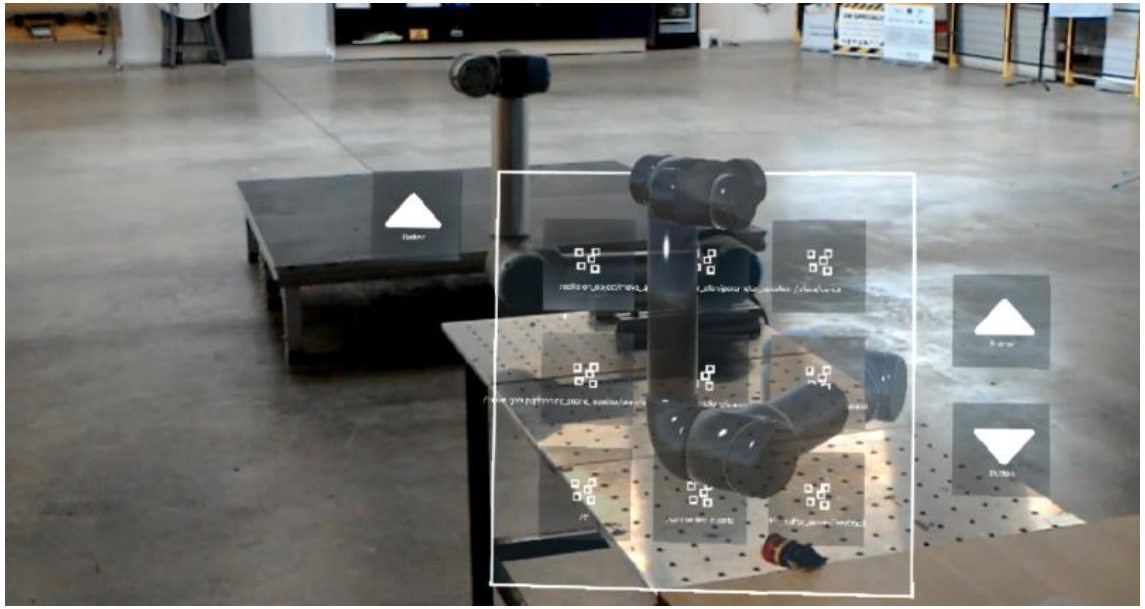
- Intel RealSense
- Kinect v1 and v2,

MirrorLabs framework

Implemented use case:
Use case 1 - hologram twin
in HoloLens







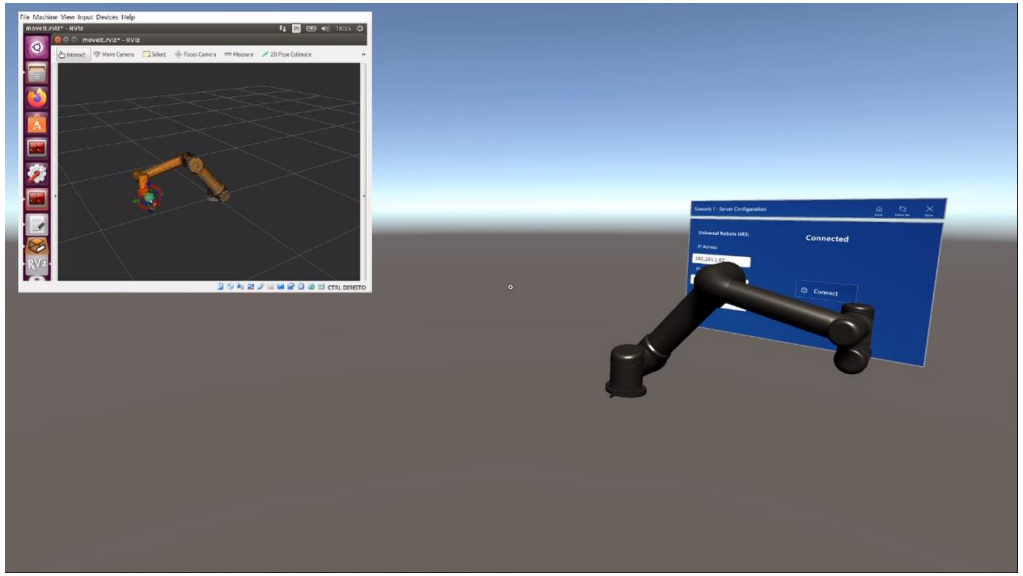
MirrorLabs framework

Implemented use case:

Use case 1 - hologram twin in HoloLens

Use case 2 - virtual twin in ROS

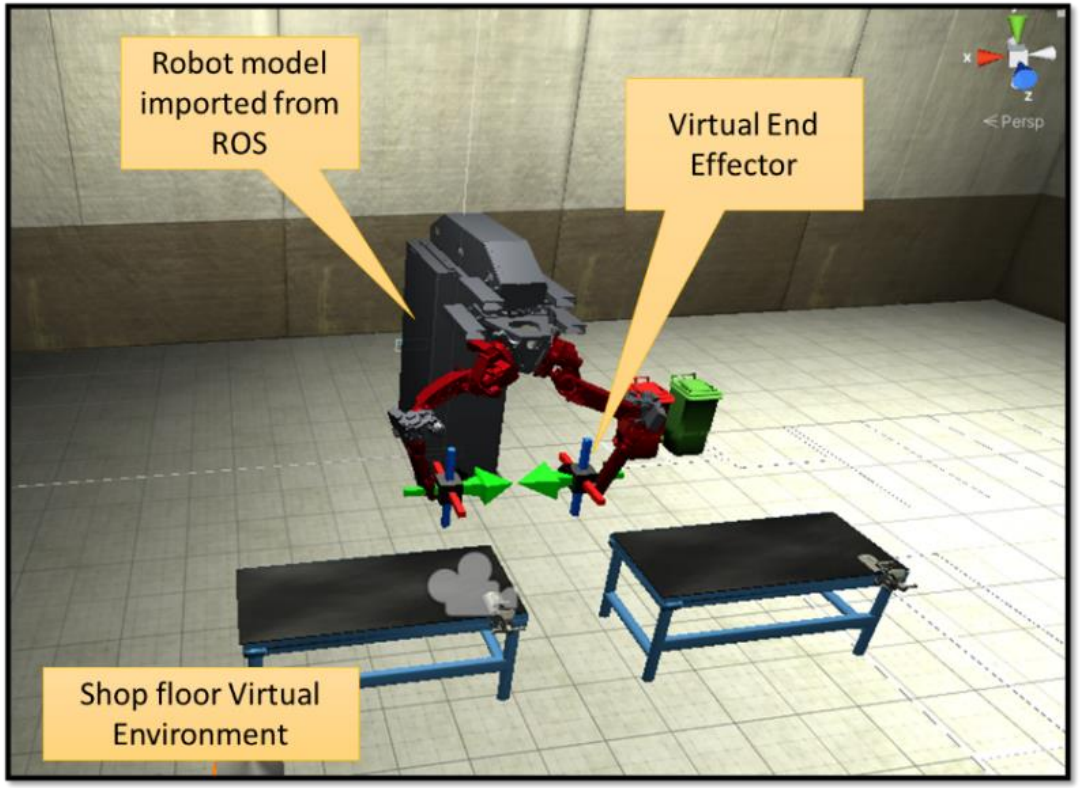
Use case 3 - Virtual twin from ROS in VR

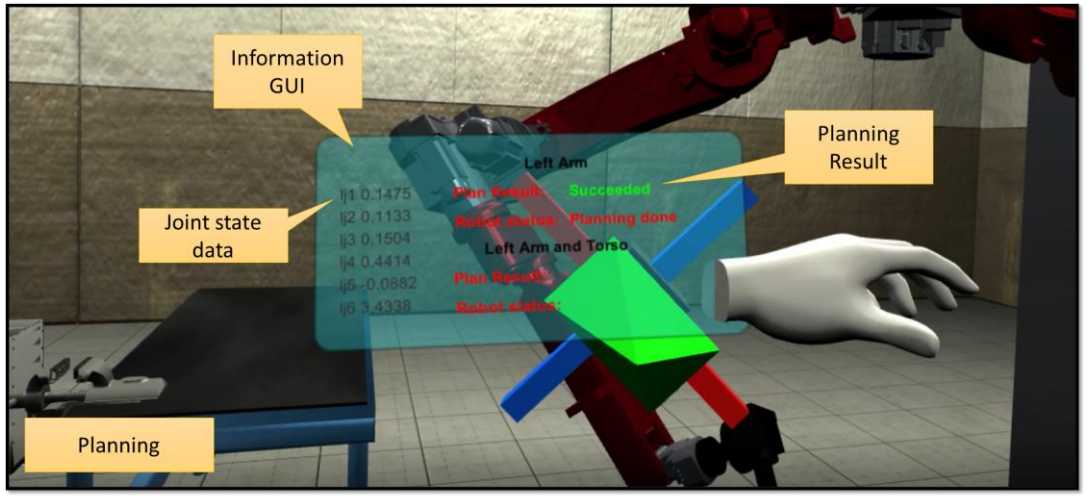


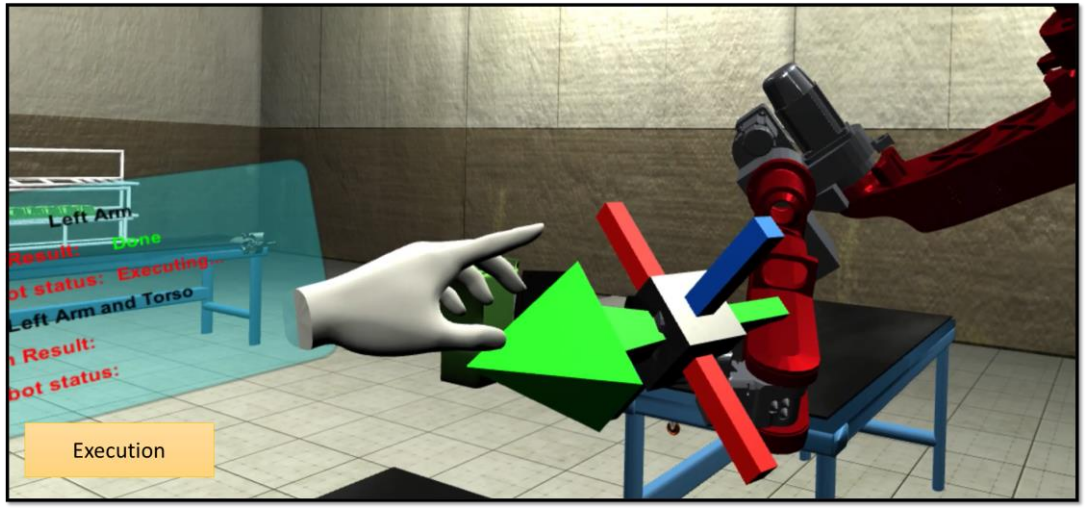
MirrorLabs framework

Implemented use case:

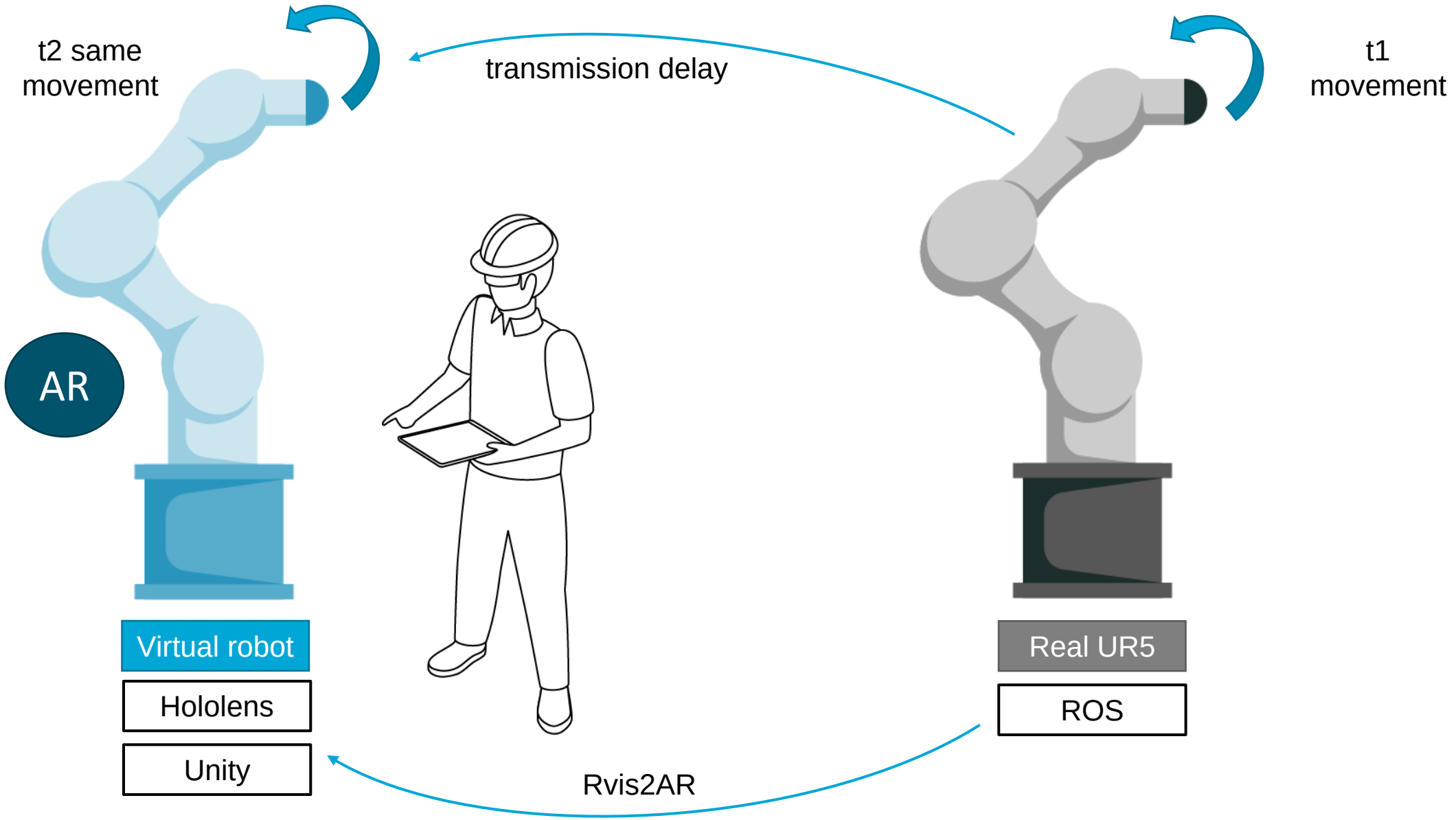
Use case 6 - VR input for virtual robot in ROS



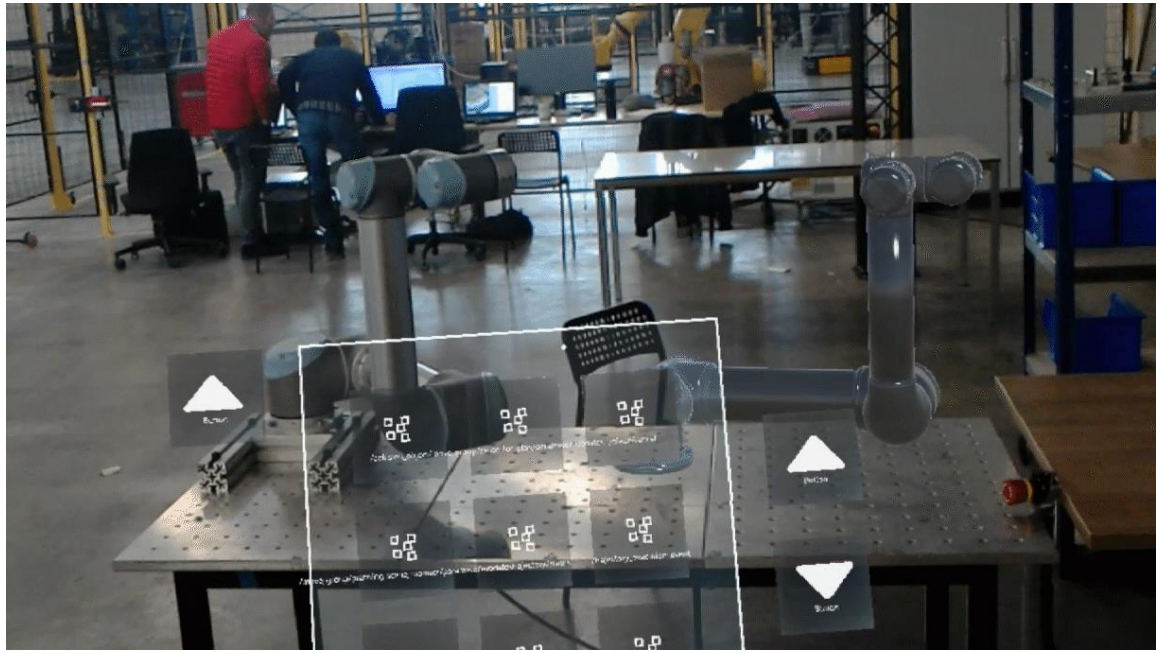




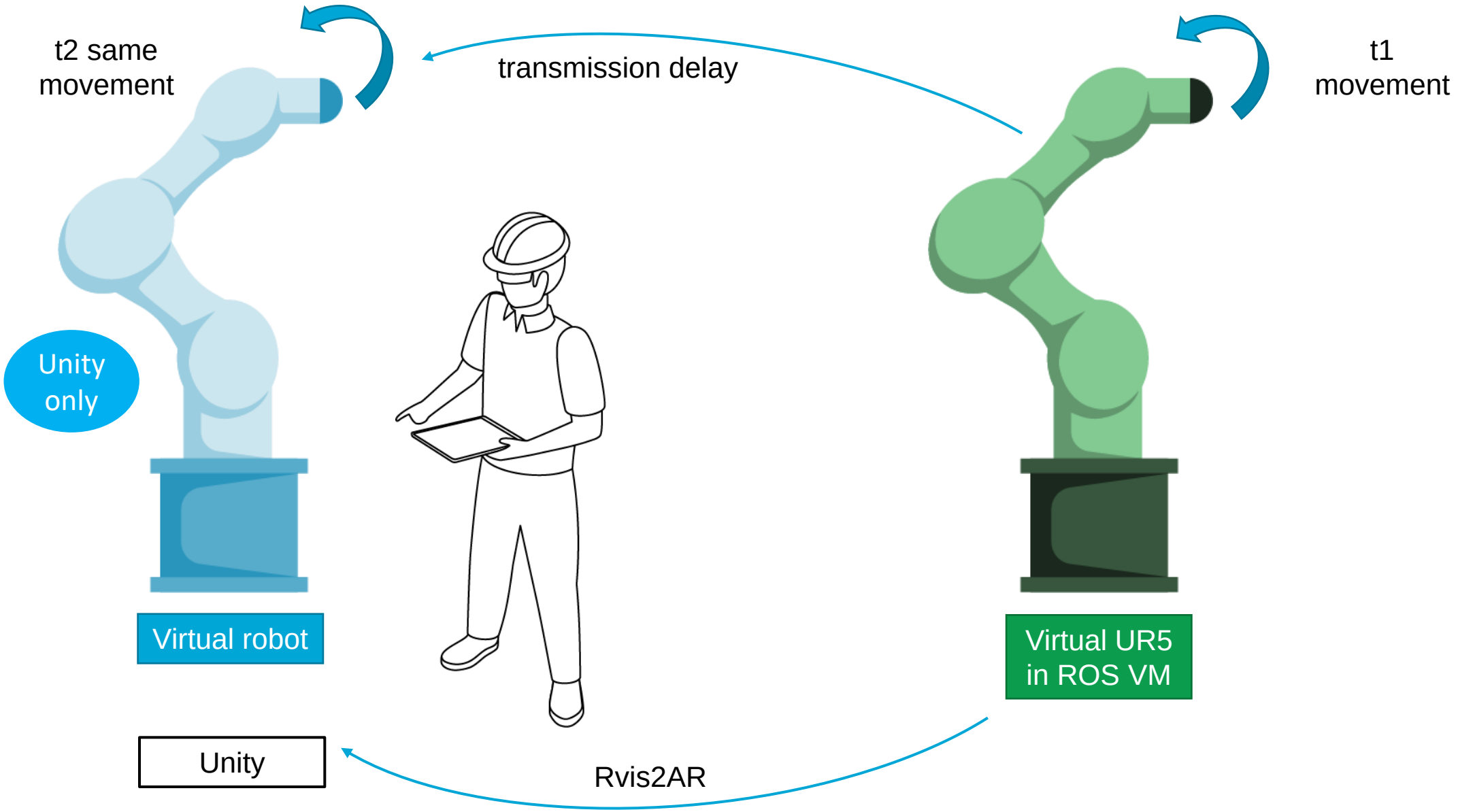
Use case 1 – hologram twin in HoloLens



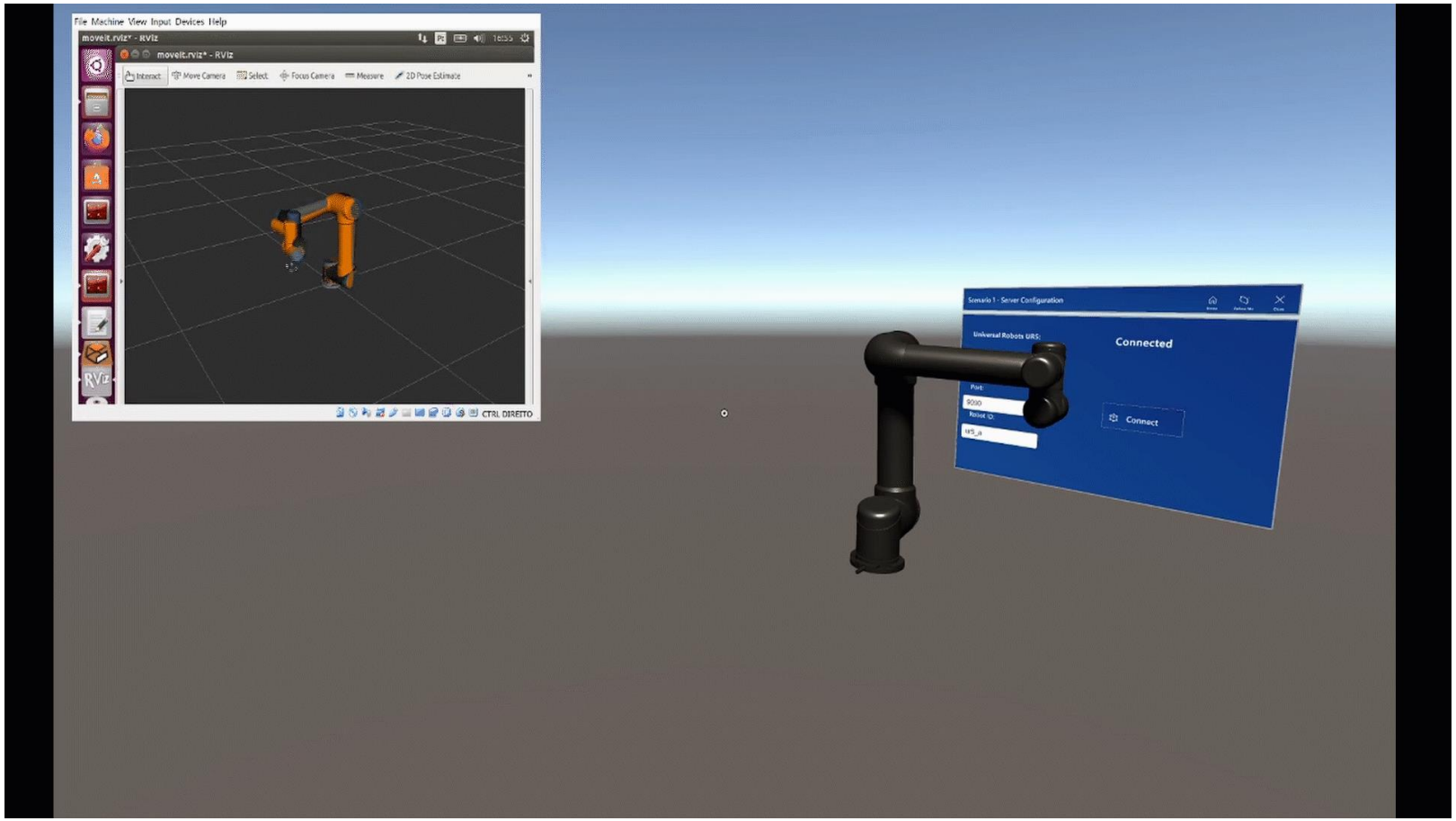
Use Case 01 development – hologram twin in HoloLens



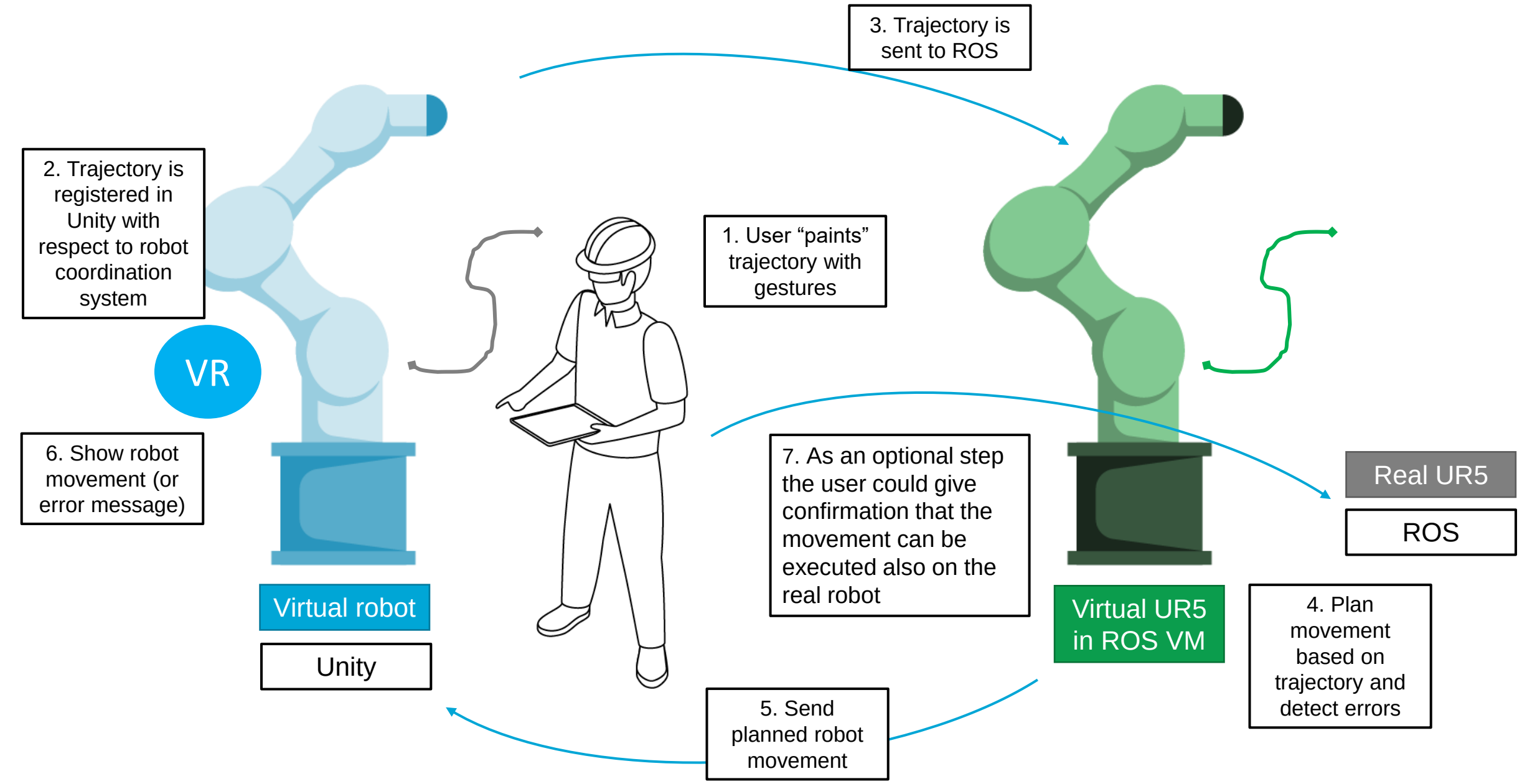
Use case 2 – virtual twin in ROS



Use case 2 developement– virtual twin in ROS

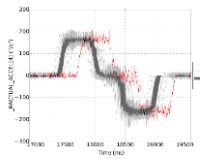


Use case 6 – VR input for virtual robot in ROS

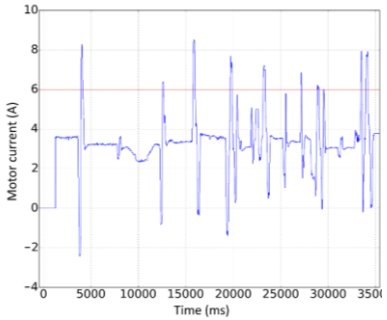


Use case 6 development – VR input for virtual robot in ROS

VR data presentation

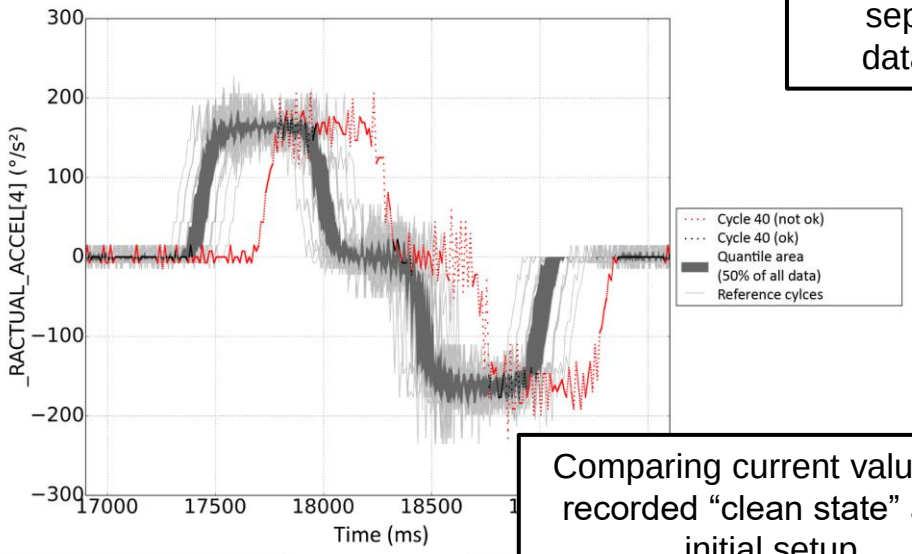


Information screens can hover at corresponding joint

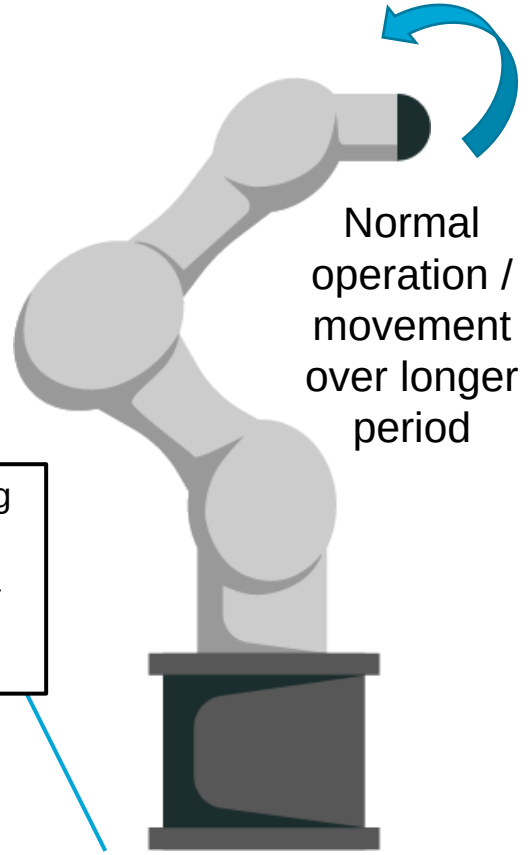


Virtual UR5 in ROS VM

Data analysis in VR is an upcoming field which has a lot of potential for factory analysis / optimization



All data during operation is captured in a separate database



Normal operation / movement over longer period

Real UR5

ROS

Virtual robot

VR equipment

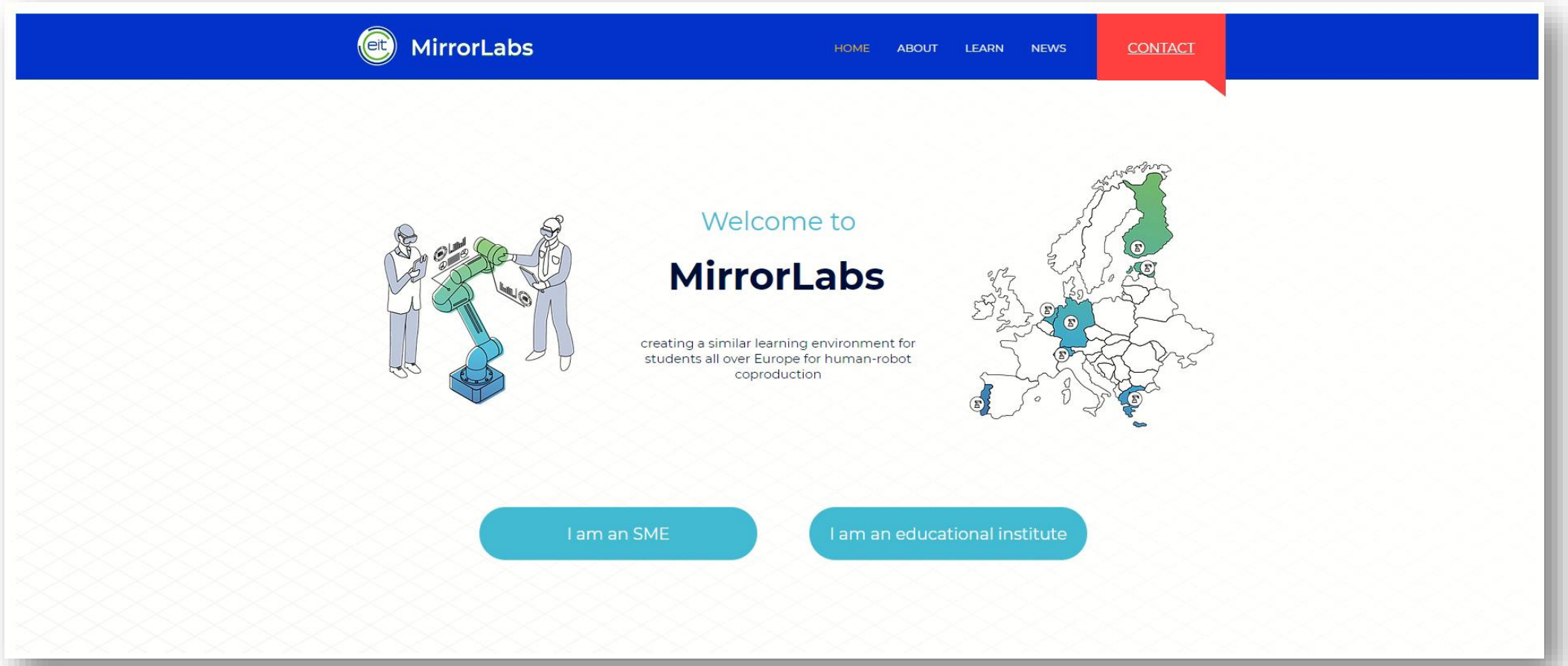
Unity

Comparing current values to recorded “clean state” after initial setup

Website

The framework is published on the git, to which there is a link on the MirrorLabs-website: http://mirrorlabs.eu/

The website also includes an introduction about the project and what we do for SME's and educational institutes, and we post updates on the site about the project, showcases and tutorials.



Questions?