stereopsia

Large-area Tracking and Rendering for Extended Reality

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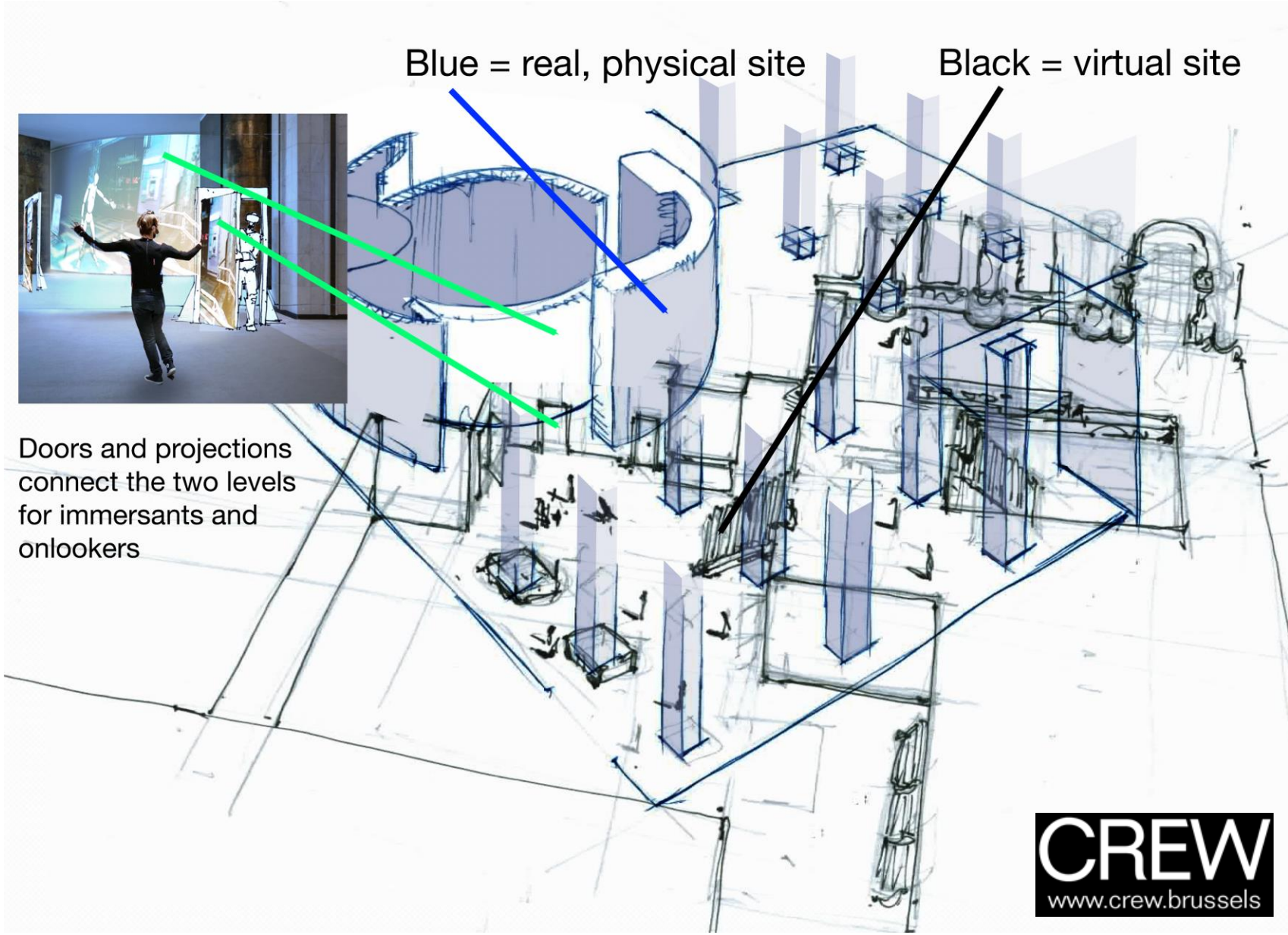
CREW www.crew.brussels

maXR

Co-funded by the European Union

Co-location

The physical and virtual spaces are aligned either by placing virtual objects on physical attributes in AR or by enabling VR experiences where virtual elements correspond to physical ones.



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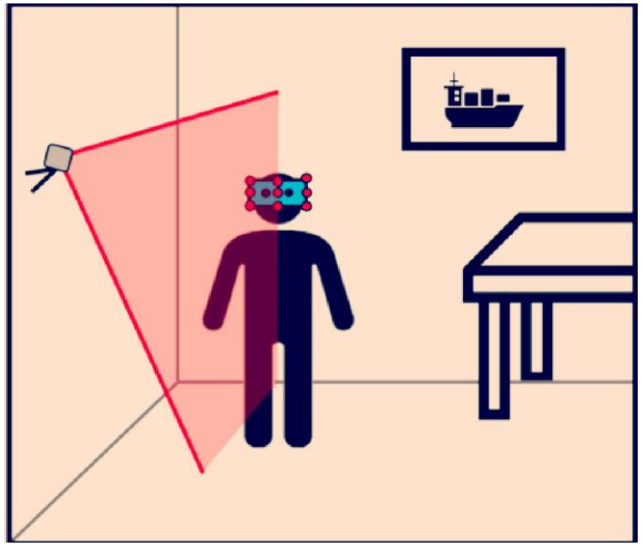
Localization in XR



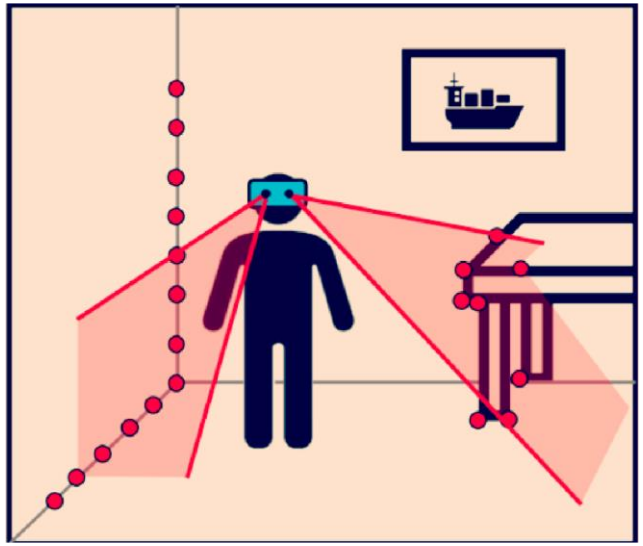
Outside-in tracking

Headset localization facilitated by external sensors (cameras, optical base stations, acoustic trackers, ...)

+ Accuracy

- Costly

- Requires modifications to the physical environment



Inside-out tracking

They require keeping tens of thousands of animals in a small space

+ Cheap

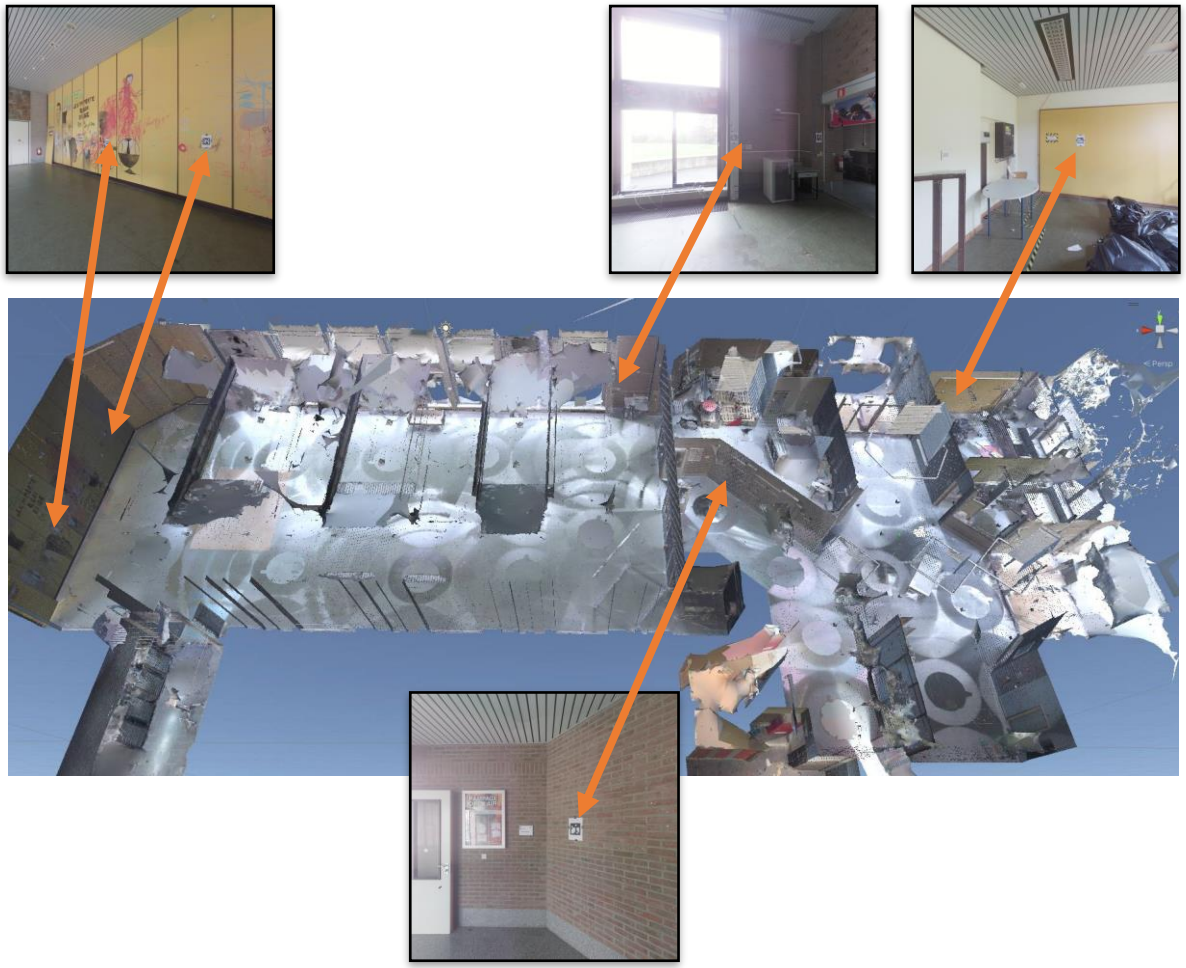
+ No/minimal modifications to the physical environment

- Prone to drift accumulation

Preprocessing Phase

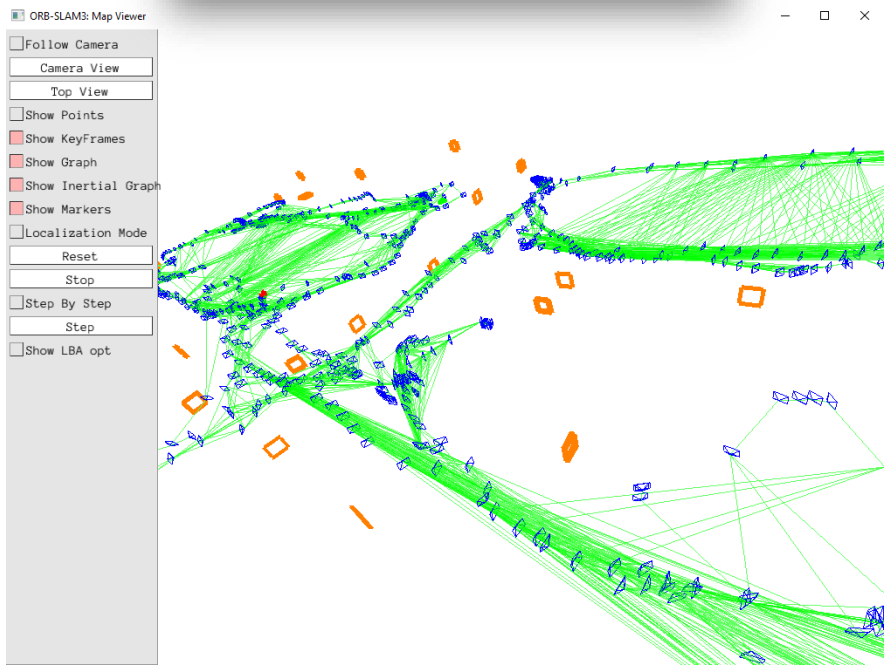
Capture 3D laser scan

Detect ground truth poses of ArUco markers



Capture SLAM map

Detect features + ArUco markers



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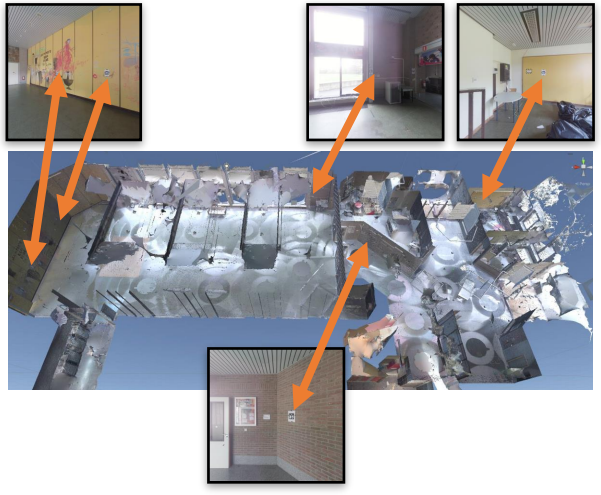

Capture SLAM map
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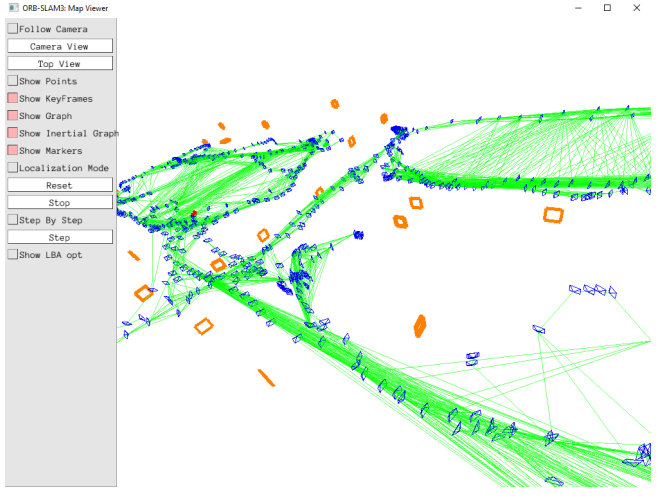
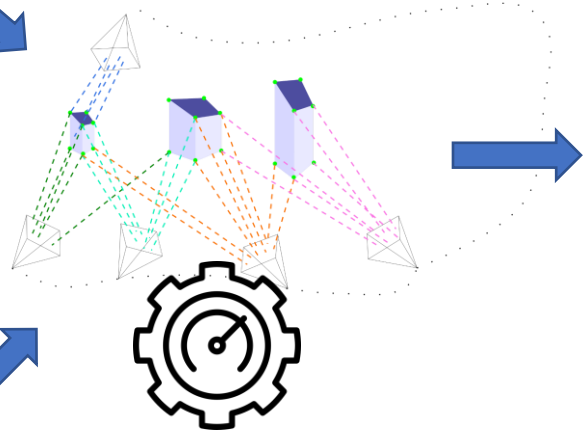
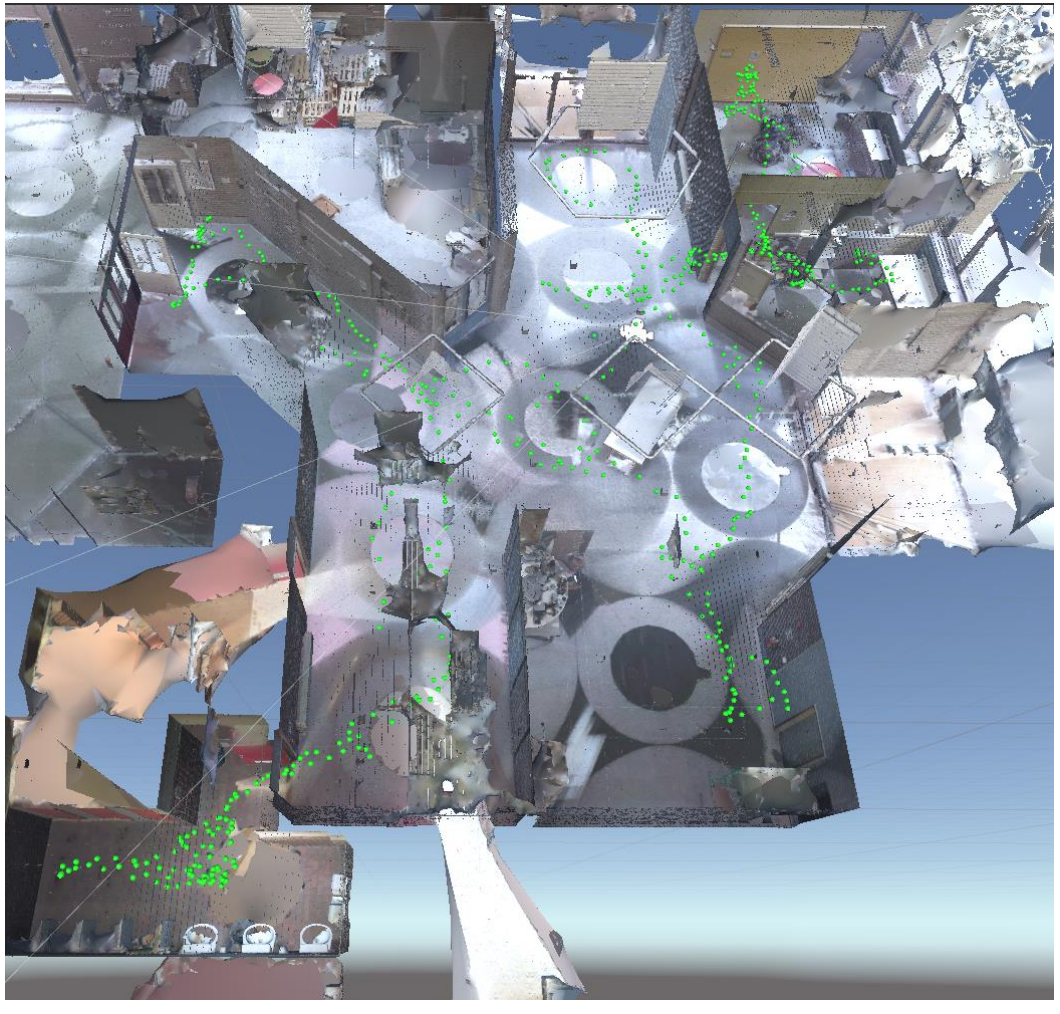


ORBSLAM3 pose graph optimization by constraining new ArUco observations



Spatially aligned SLAM tracking map



Live Localization

The SLAM map is **registered and aligned with the global 3D scan** of the environment, and can be used to localize the camera. When performing SLAM in localization mode only, the system returns the **pose of the camera with respect to the global frame**, and thus aligned with the real environment

Headset Fusion

Global localization (ORBSLAM3)

$(x, y, z, \varphi, \theta)_{global}$

± 20 Hz

Headset localization

$(x, y, z, \varphi, \theta)_{headset}$

Prone to drift!

± 75-120 Hz

$(\Delta x, \Delta y, \Delta z, \Delta\varphi, \Delta\theta)_{drift}$

Kalman filter

correct drift

$(x, y, z, \varphi, \theta)_{headset_global}$

Evaluation Datasets

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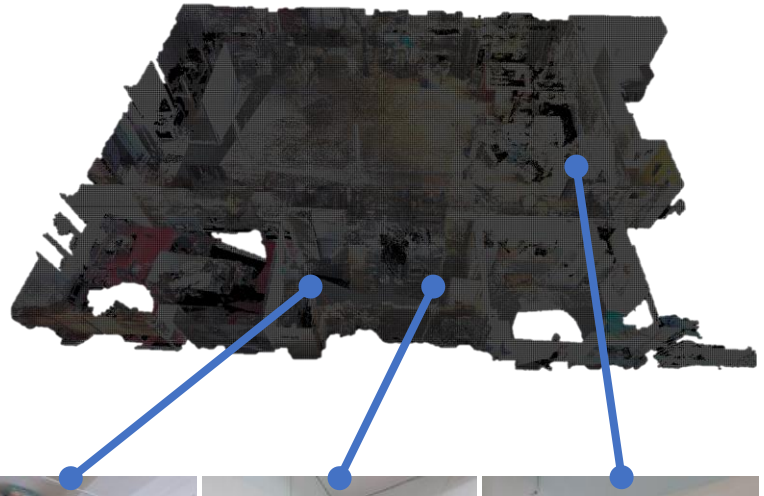
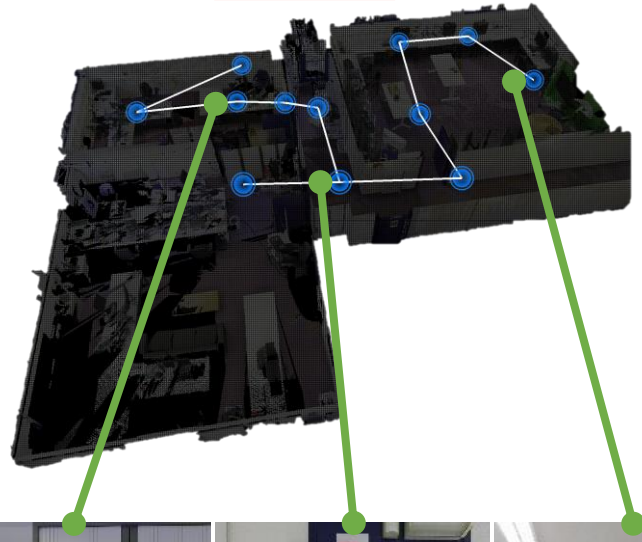


± 250m²
± 9 rooms
205M points

XRHuis



± 160m²
± 5 rooms
497M points

MakerSpace

± 312m²
± 4 rooms
1058M points

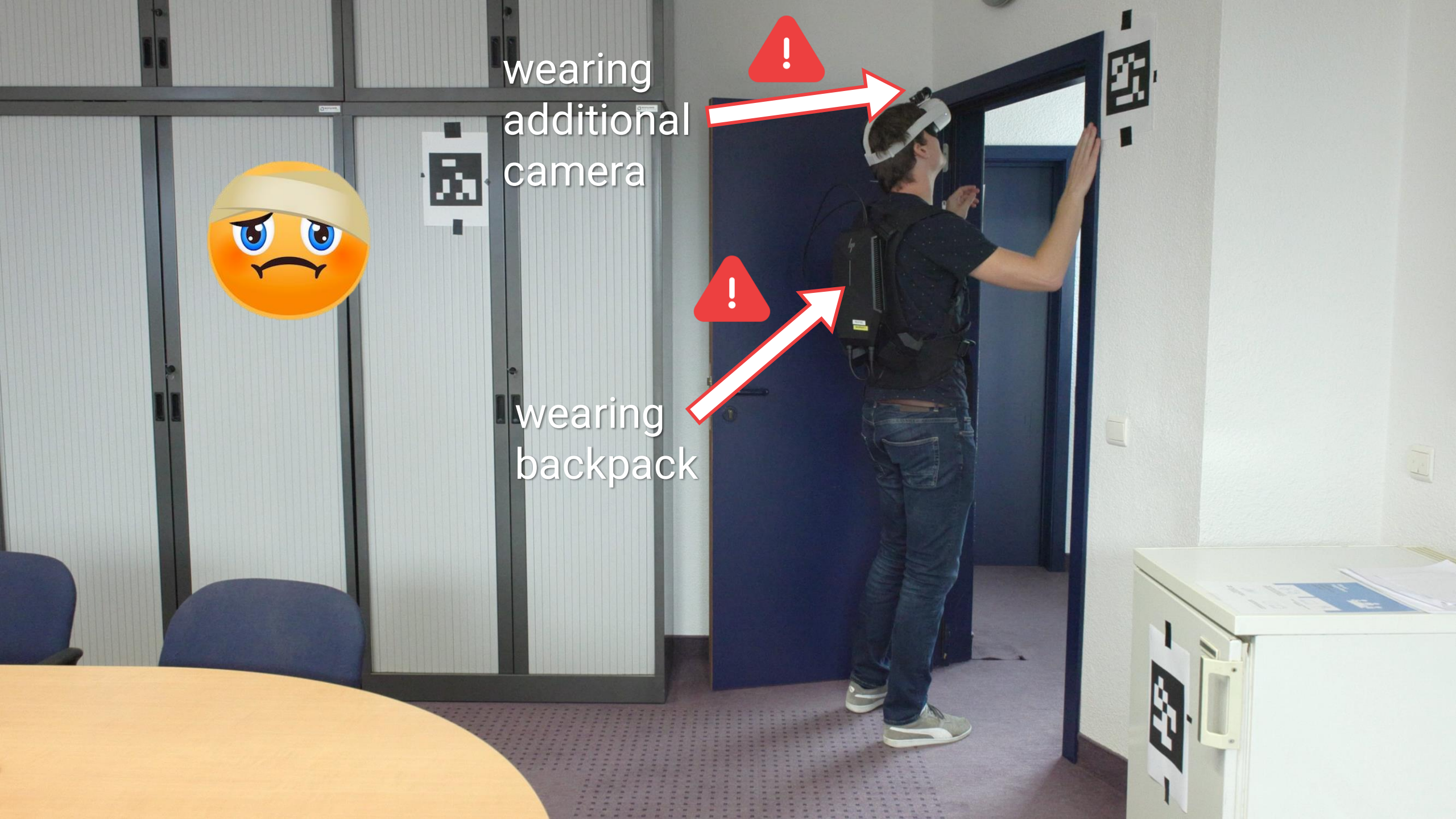
Comparing with 3D point cloud…

Left: ground truth keyframe images as captured by the camera.

Middle: overlay of the ground truth keyframe images with the rendered keyframe as estimated by SLAM.

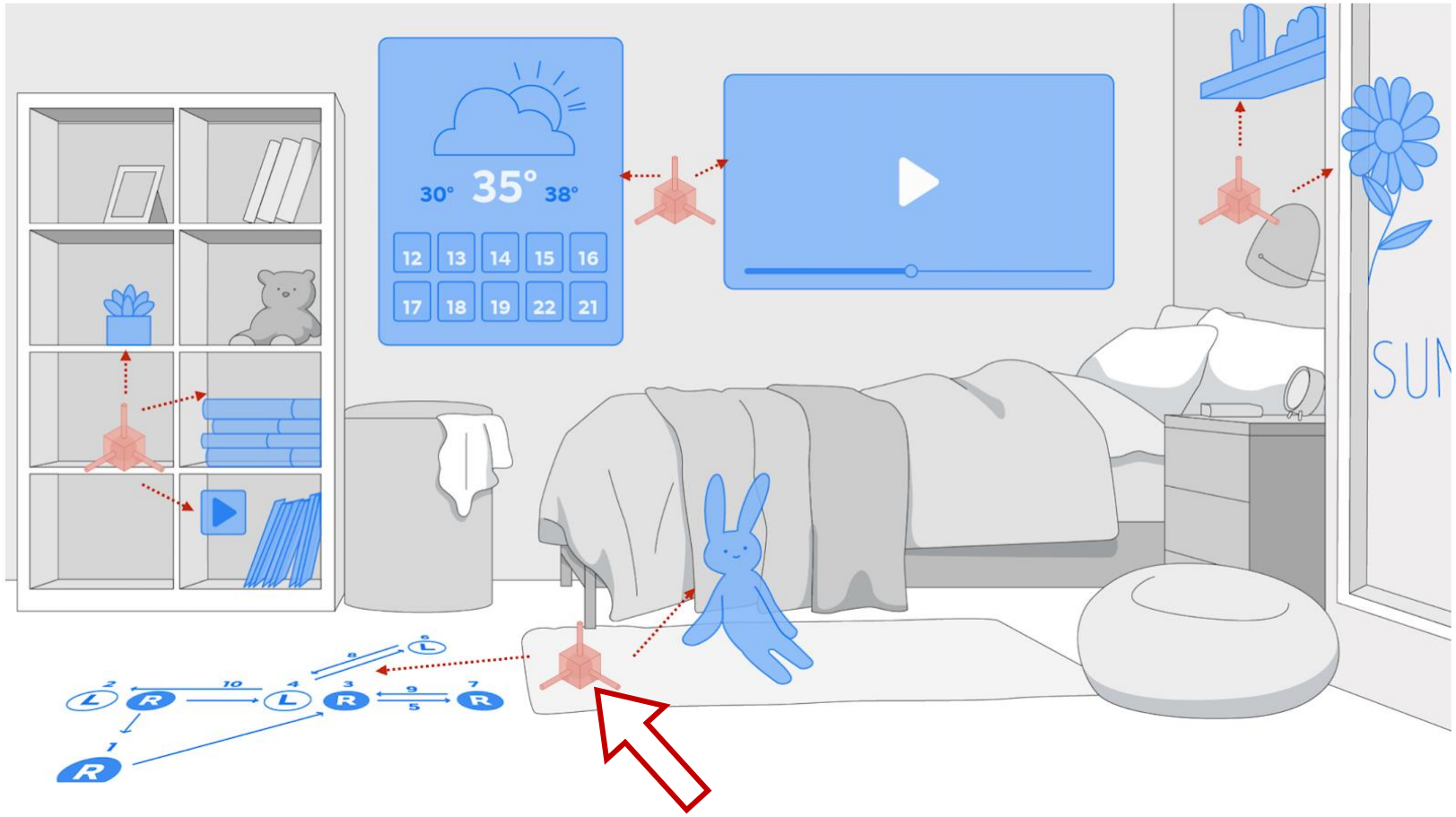
Right: Refined alignment

Tracking and Co-Location of Global Point Clouds for Large-Area Indoor Environments
Michiels Nick, Jorissen Lode, Put Jeroen, Vandebroeck Isjtar, Joris Eric & Van Reeth Frank. Virtual Reality 28, 106 (2024). doi: 10.1007/s10055-024-01004-0


wearing
additional
camera
wearing
backpack

Spatial anchors

Spatial anchors are SDK features supported by many popular headsets. They allow recording reference points in the physical world that are tracked and corrected for drift. They are typically used for AR **to keep content "in-place“ locally.**

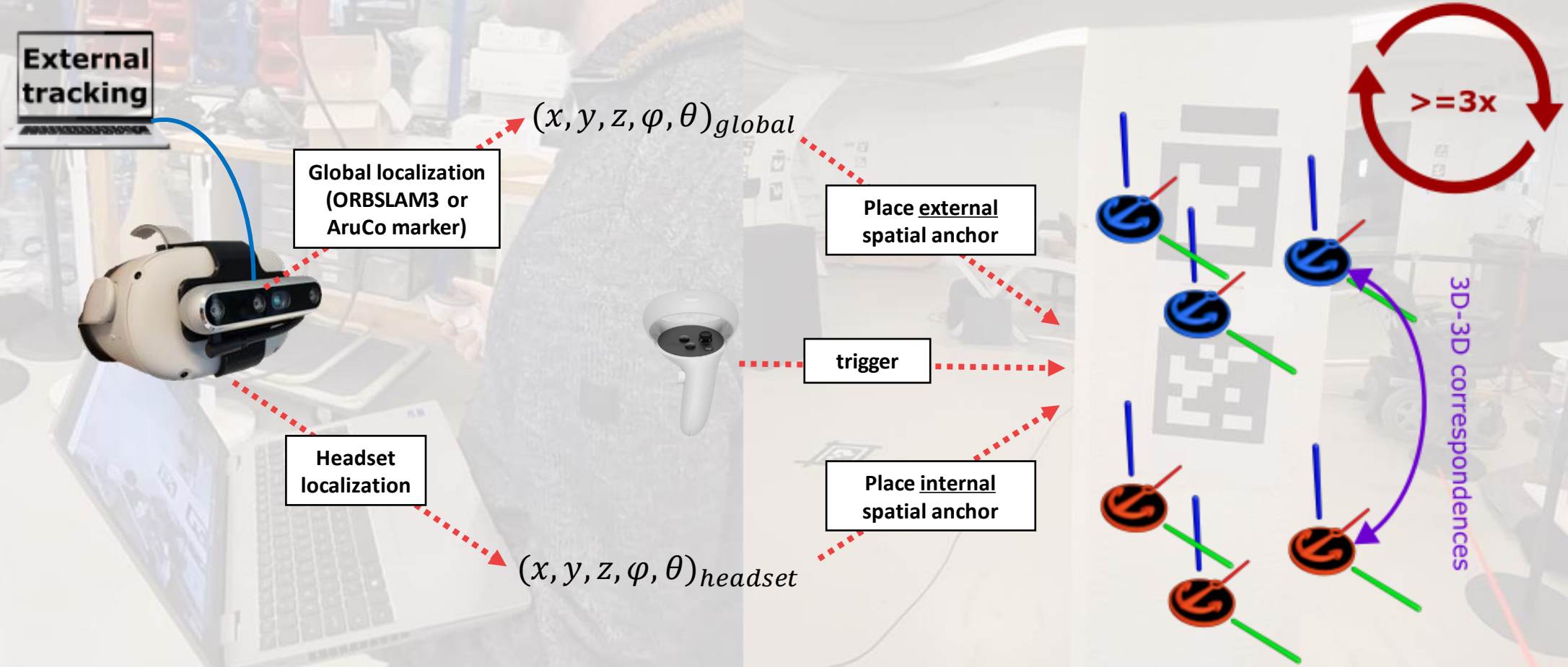


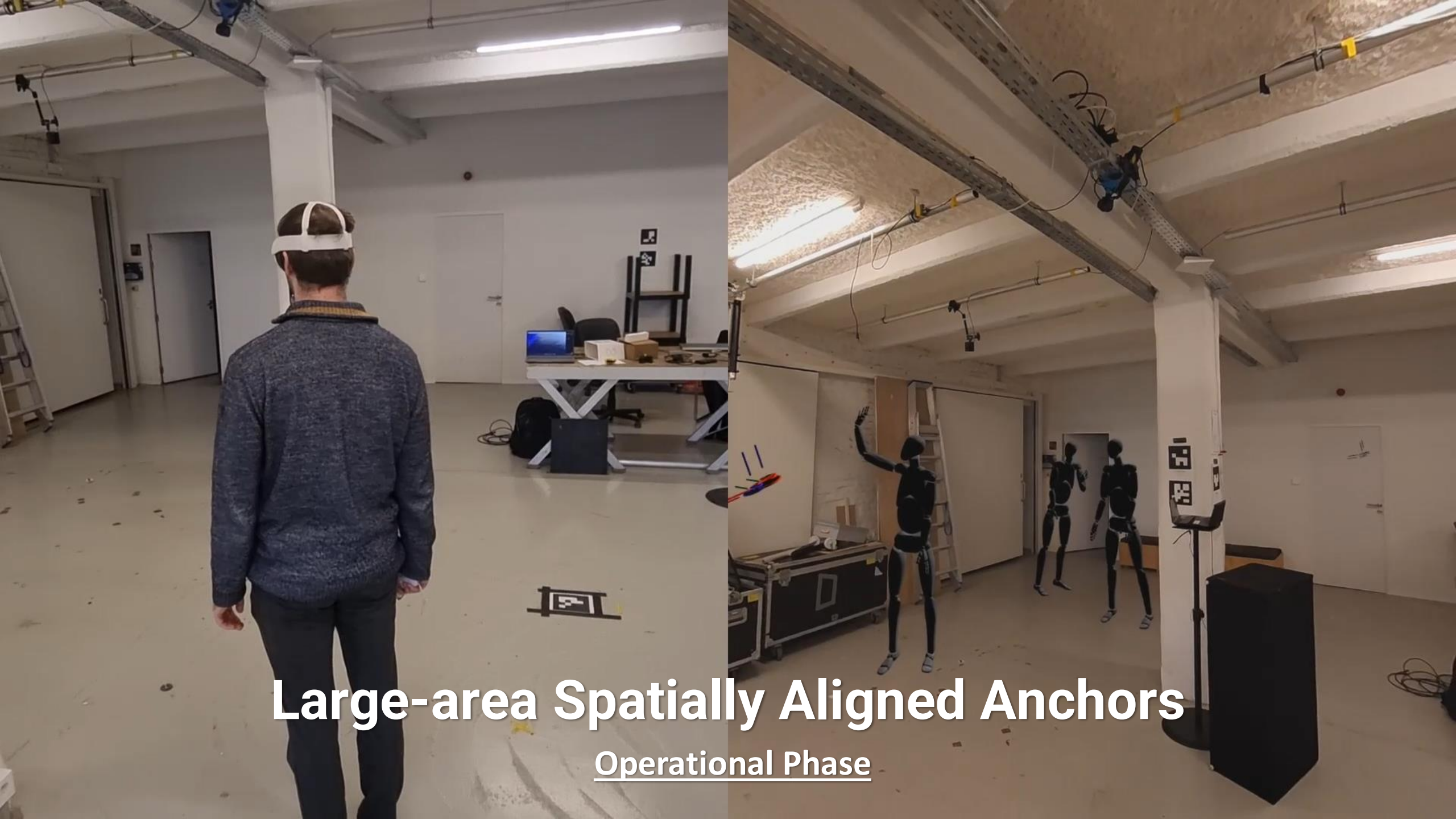
only supports local content authoring!

Large-area Spatially Aligned Anchors
Preparation Phase

Large-area Spatially Aligned Anchors

Preparation Phase





Large-area Spatially Aligned Anchors

Operational Phase

Large-area Spatially Aligned Anchors

Operational Phase

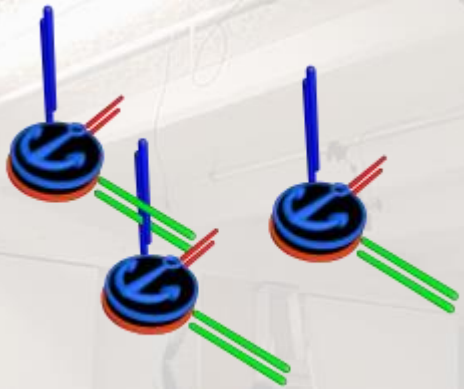
external camera
no longer needed

Retrieve internal spatial anchor

$(x, y, z)_{anchor}$

Lookup external spatial anchor

3D-3D correspondences



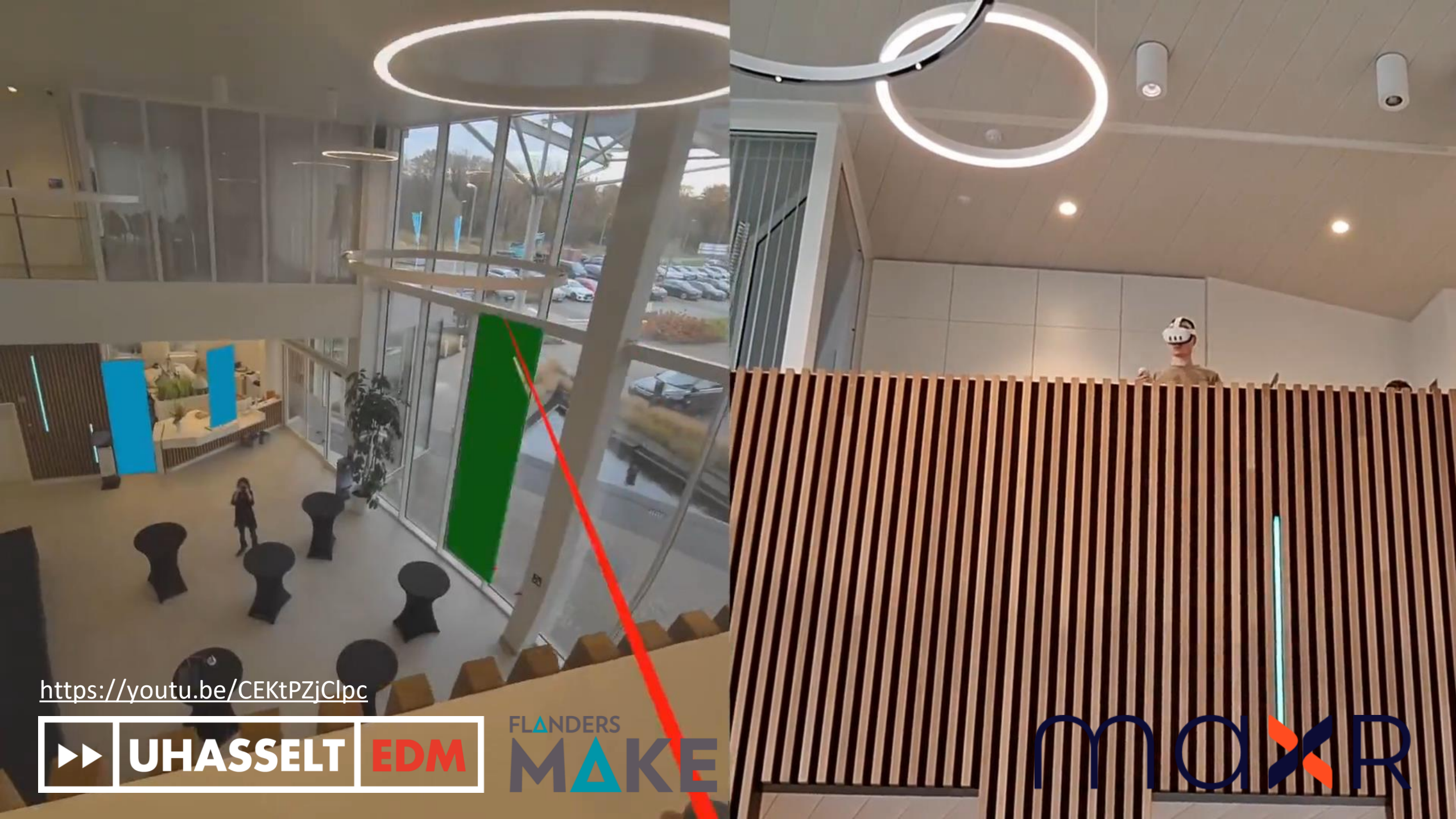
Cloud registration

Least-squares fitting through SVD
Variants:
static/weighted

Transformation T

Transform headset camera to align with global position

globally aligned camera


https://youtu.be/CEKtPZjClpc
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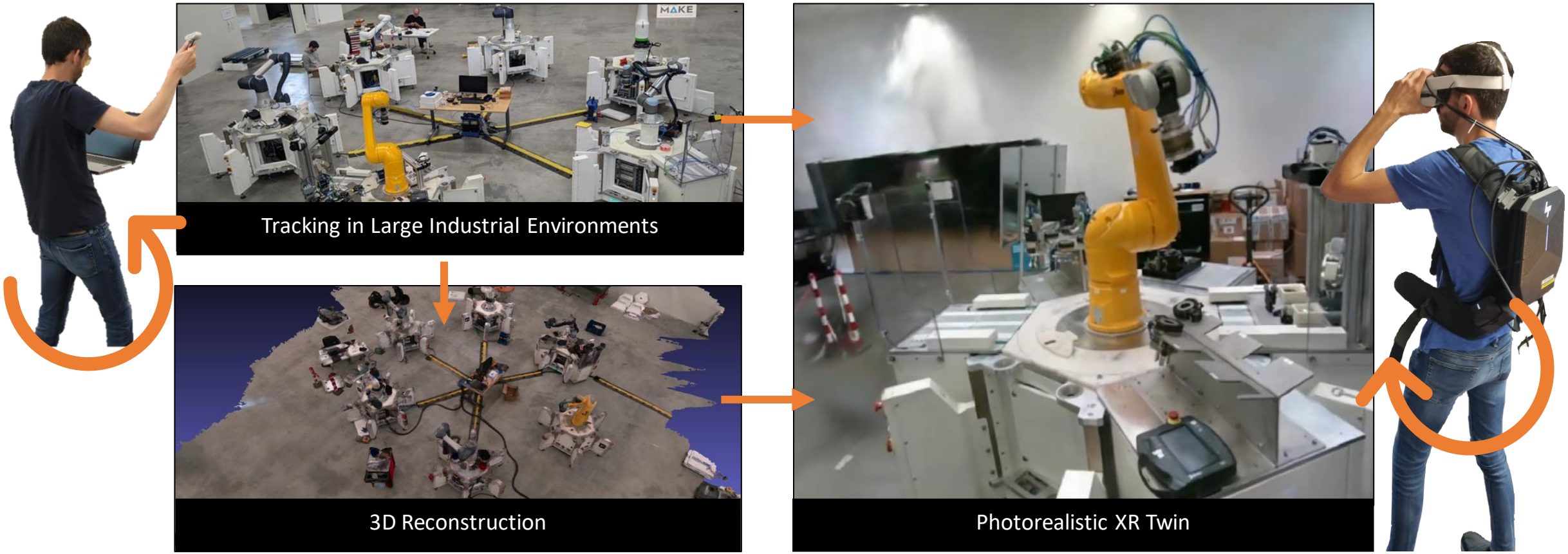
XRtwin SBO

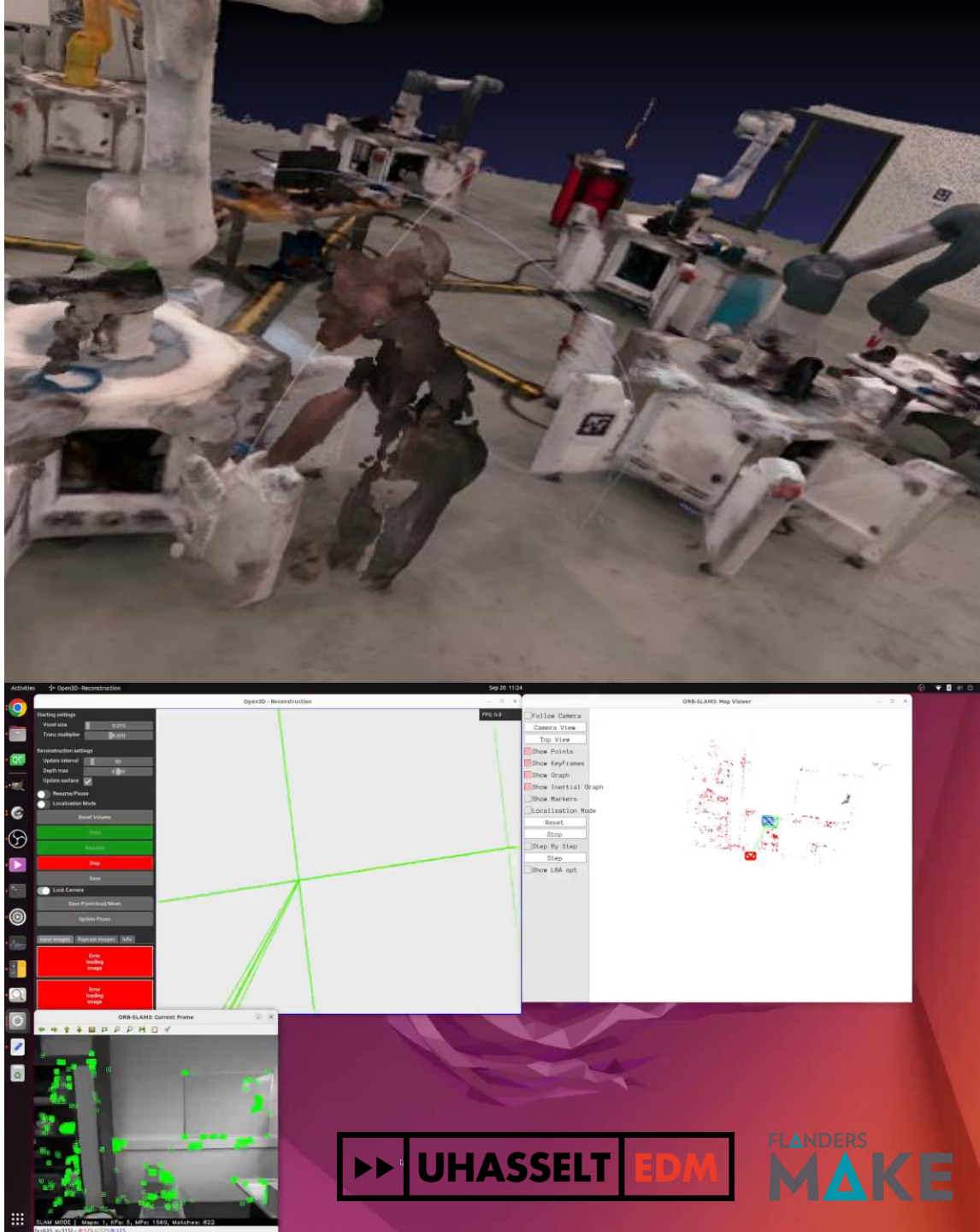
Cost-efficient authoring of **large interactive** industrial objects and dynamic environments for XR consumption



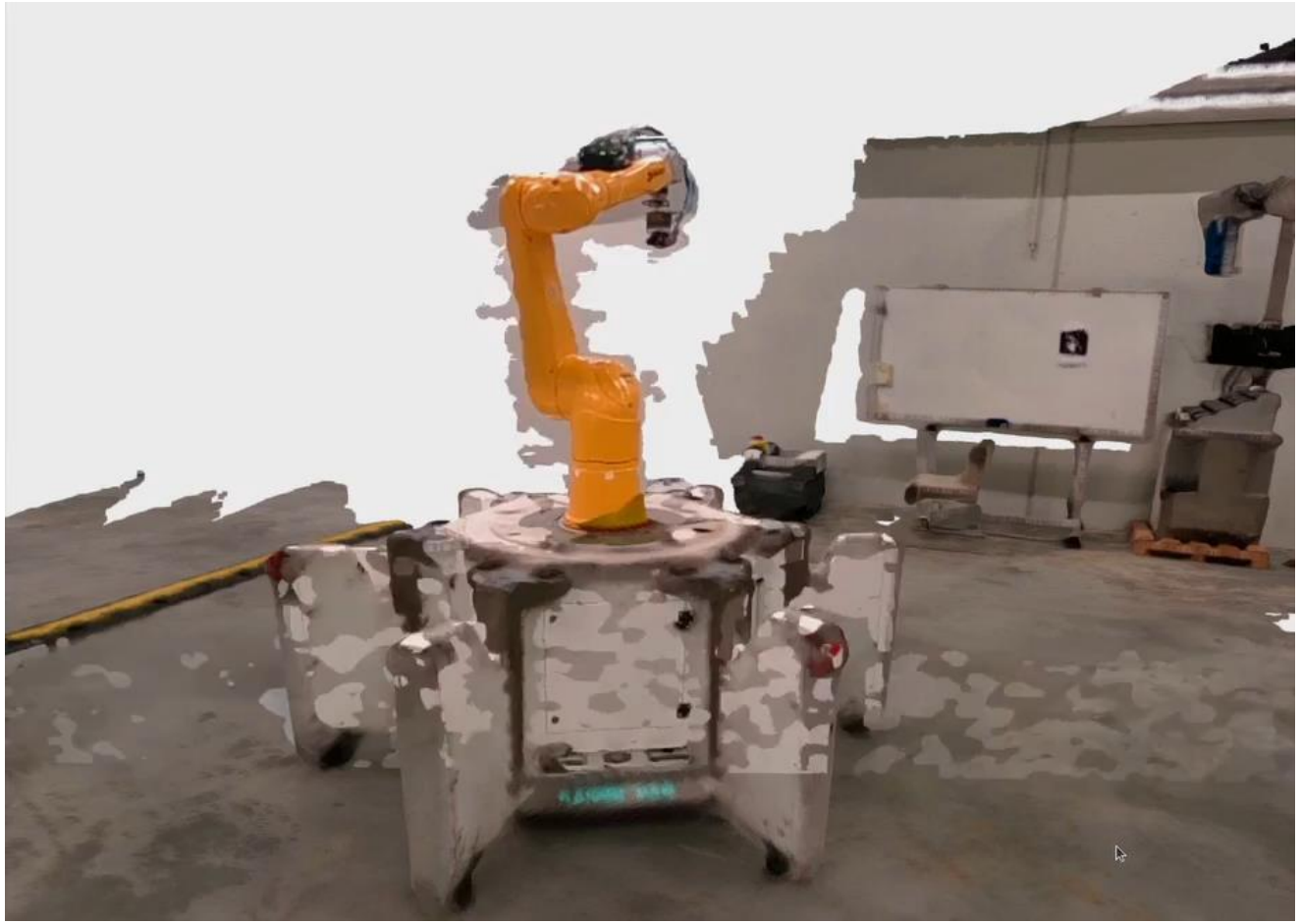
Cost-Efficient Scanning

A **non-experienced** user can perform the scan walking around with a scanner (Intel RealSense D455) and a laptop. The system…

- automatically filters out people and moved objects
- offers guidance using visual clues
- offers incremental reconstruction



XRtwin SBO



scanning **objects** that are **animated**

increasing **photorealism** using 3D Gaussian Splatting

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Large-area Demo @ Stereopsia
9th December
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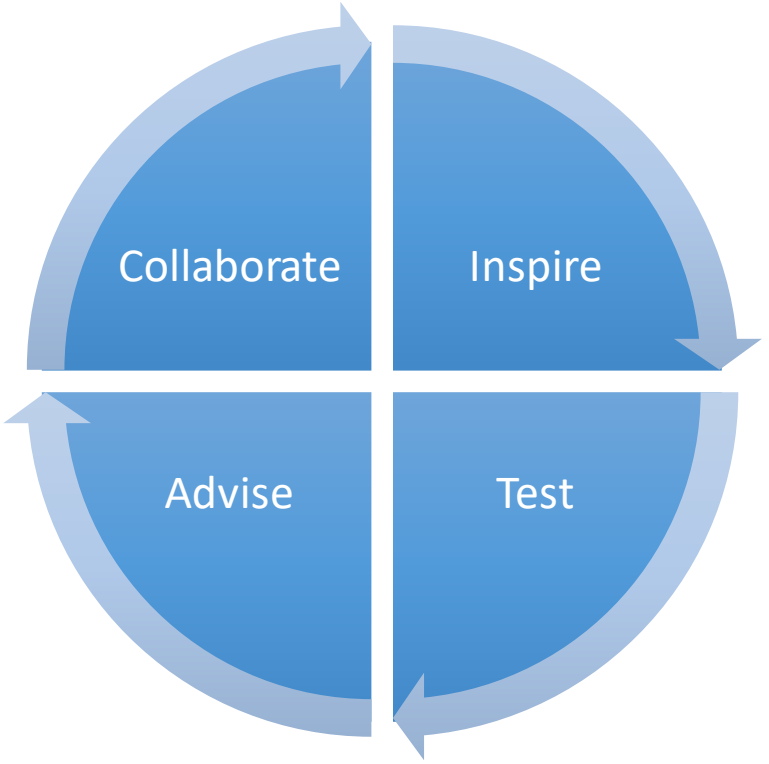
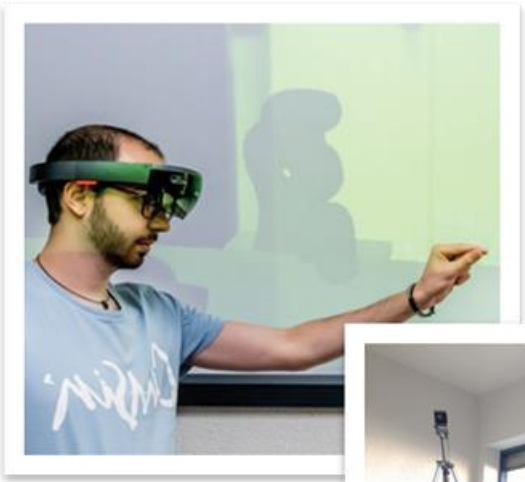
XR living labs and Infrastructure





AR4Industry

VLAANDEREN INDUSTRIE 4.0

XR@Work

INVESTEERT IN JOUW TOEKOMST

ESF

MAXVR-INFRA

Gefinancierd door de Europese Unie

NextGenerationEU

XR-Huis

provincie Limburg

PROJECT SALKturbo DIGITAAL LIMBURG

maxR

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