trinity

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www.trinityrobotics.eu

AGILE Consortium

- AGILE consortium is composed by two companies:

allbesmart

- a Portuguese SME, established in 2015 that provides engineering services and technology expertise on IoT and Industry4.0

StoneShield ENGINEERING

- a Portuguese SME, established in 2017 that manufactures industrial machines for the automotive cable assembly industry

AGILE Context

- Assembly of electric cables for the automotive industry:
  - is a process with significative manual work
  - most of the factories are located in cost-effective labour countries, mainly in north Africa, Mexico and India.

AGILE Context

- 90+ million vehicles are manufactured every year
- 60% of all electric cables manufactured are installed in cars
- Car manufacturers are using increasingly smaller components
- Miniaturization raises new challenges for manual labour
- Automation increases production, reduces costs, ensures quality
- Automation requires training/education and specialized maintenance operations

https://www.youtube.com/watch?v=4oI5R02uaKQ

AGILE Position in the Automotive Value Chain

Mentorship

- Collab. Robotics
- Augmented Reality
- AI Computer Vision
- Funding

Technology Provider

Robotic Integrator
Technology Adopter

Cable
Manufacturers

Automakers

AGILE Demonstrators & TINITY Use Cases

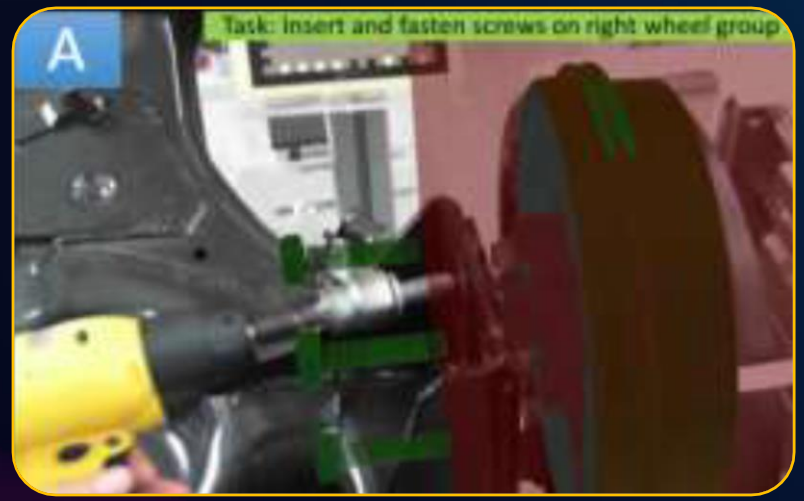
TRINITY Use case 1

Collaborative assembly with vision-based safety system.

DIH: Tampere University (Finland)

AGILE Demonstrator 1

Mentor: Morteza Dianatfar



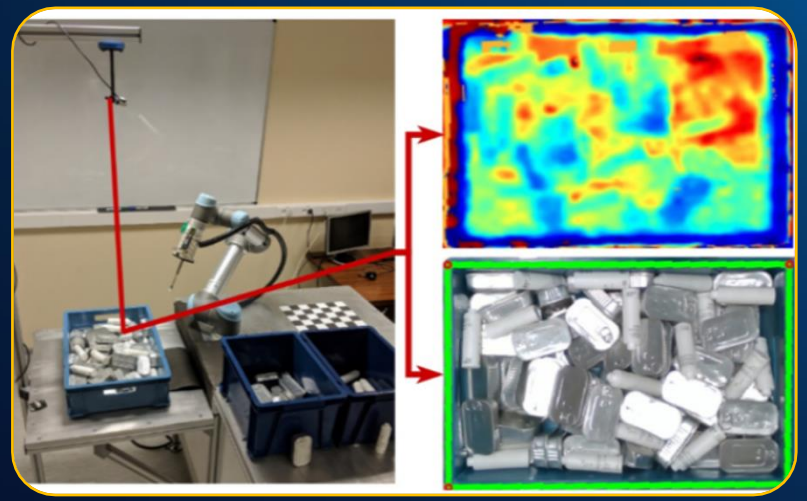
TRINITY Use case 10

HRI framework for operator support in human robot collaborative operations.

DIH: LMS-University of Patras (Greece)

AGILE Demonstrator 2

Mentor: Manto Zoga



TRINITY Use case 17

Artificial Intelligence based stereo vision system for object detection, recognition, classification and pick-up by a robotic arm.

DIH: Institute of Electronics and Computer Science, Riga (Latvia)

AGILE Demonstrator 3

Mentor: Janis Arents

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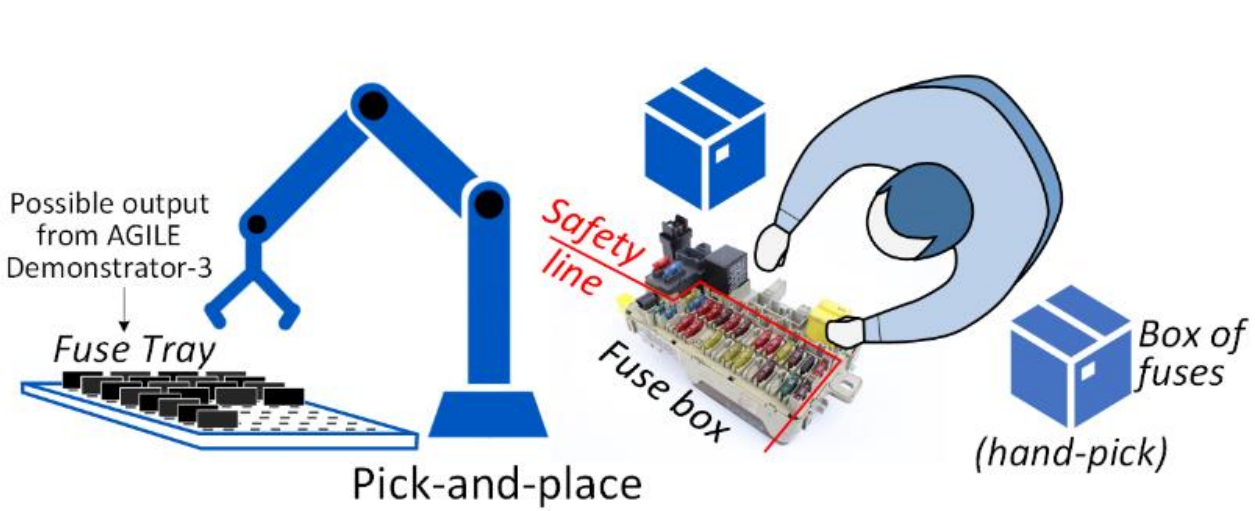
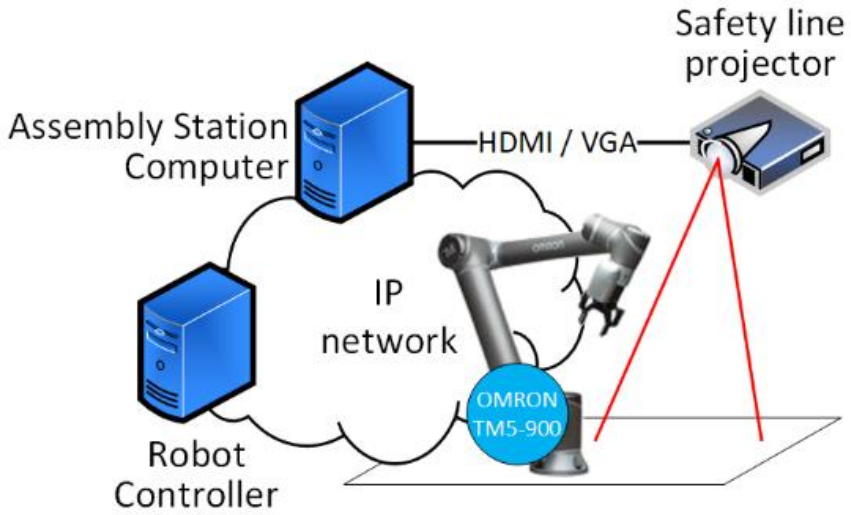
AGILE Demonstrator 1

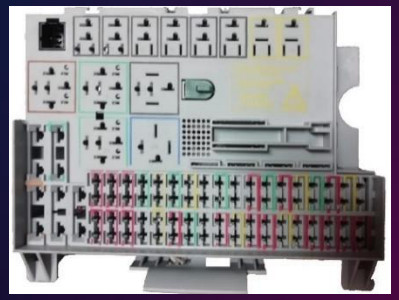
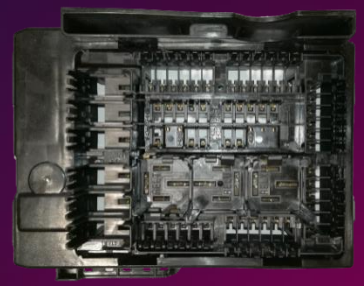
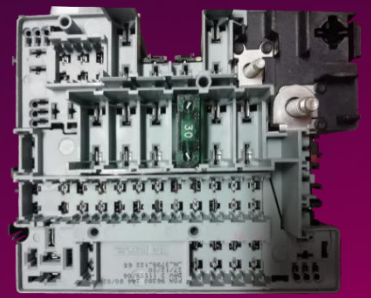
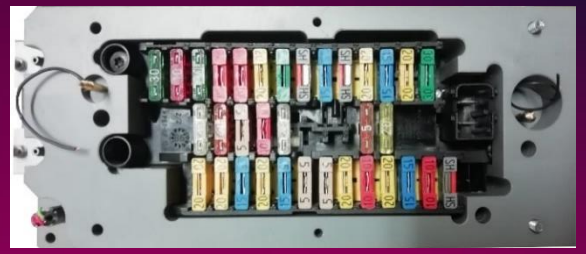
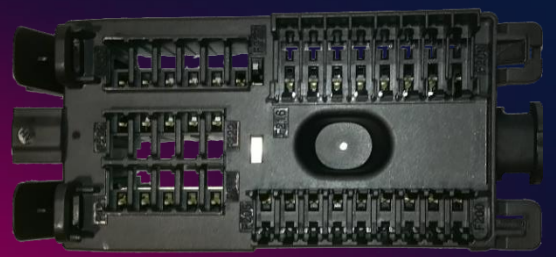


AGILE Demonstrator-1: concept



AGILE Demonstrator-1: high-level architecture

Fuse Boxes

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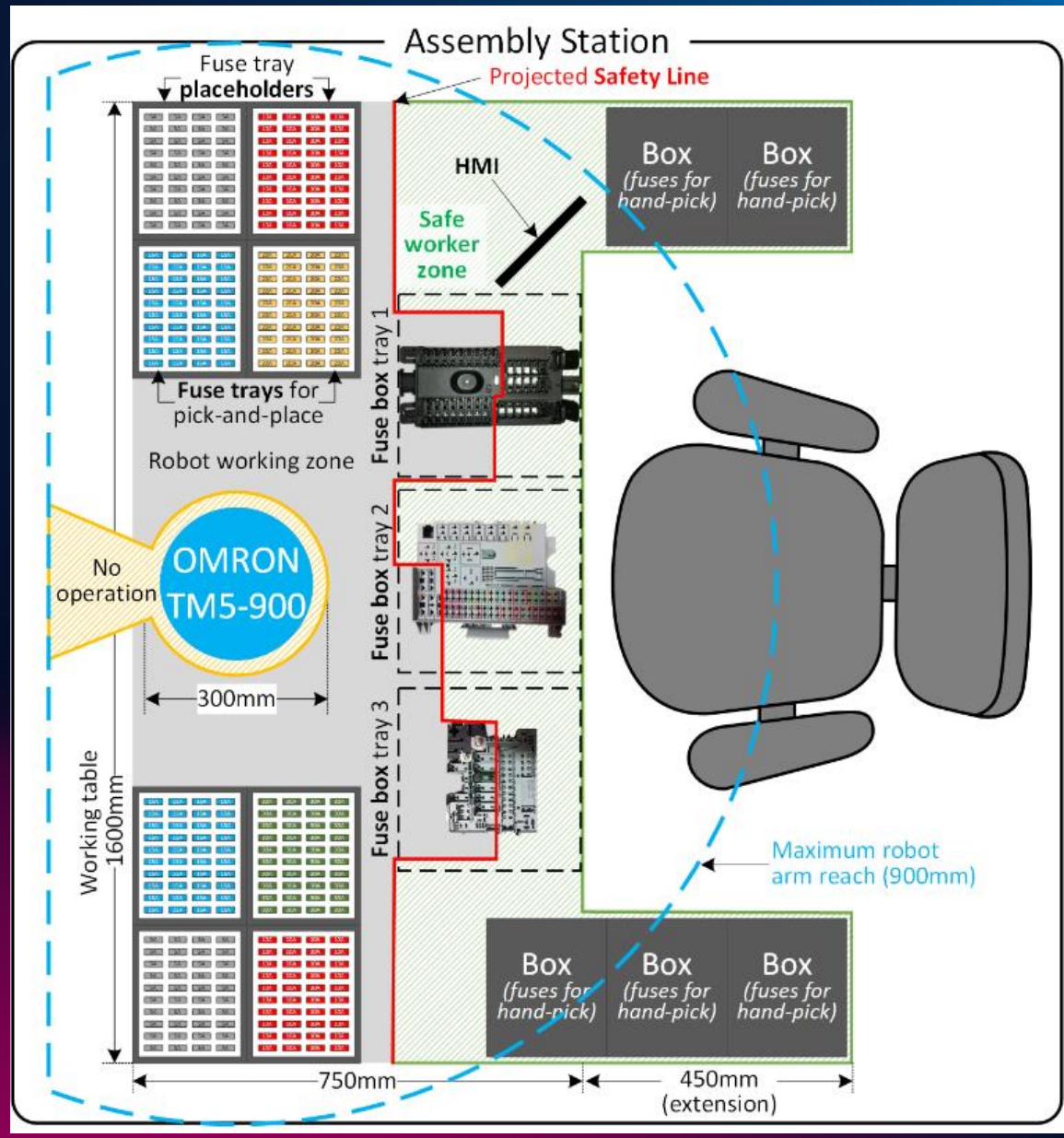
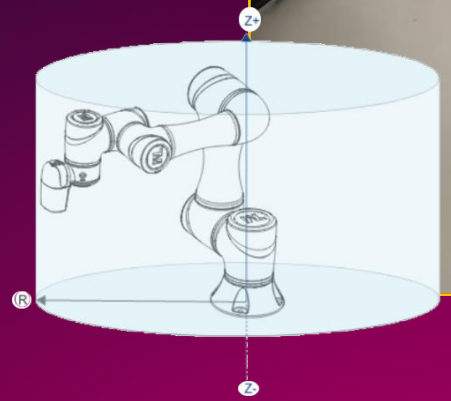
AGILE Demonstrator 1

- **Main KPI**: reach 30% decrease in the cycle time of a fuse box assembly process. Current average assembly time is 6 minutes.
- **Secondary KPI**: Optimum trajectory planning, based on different robot configuration. The goal is to reach a linear as possible trajectory considering the assembly station layout.



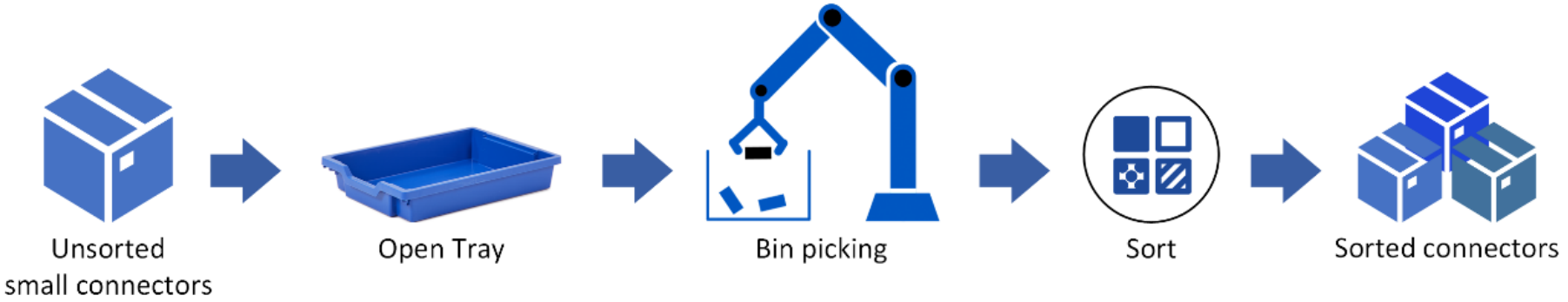
AGILE Demonstrator 1

- Next steps
  - A new gripper has been designed and manufactured for this Demonstrator (not used yet)
  - Safety line feature not yet integrated



AGILE Demonstrator 3

AGILE Demonstrator-3 concept



Connectors for reusage

Main KPI: use AI to achieve an **average cycle time of 10 seconds** for a robotic arm to successfully pick-up small plastic cable connectors in unpredictable positions, sort them and place them in different boxes

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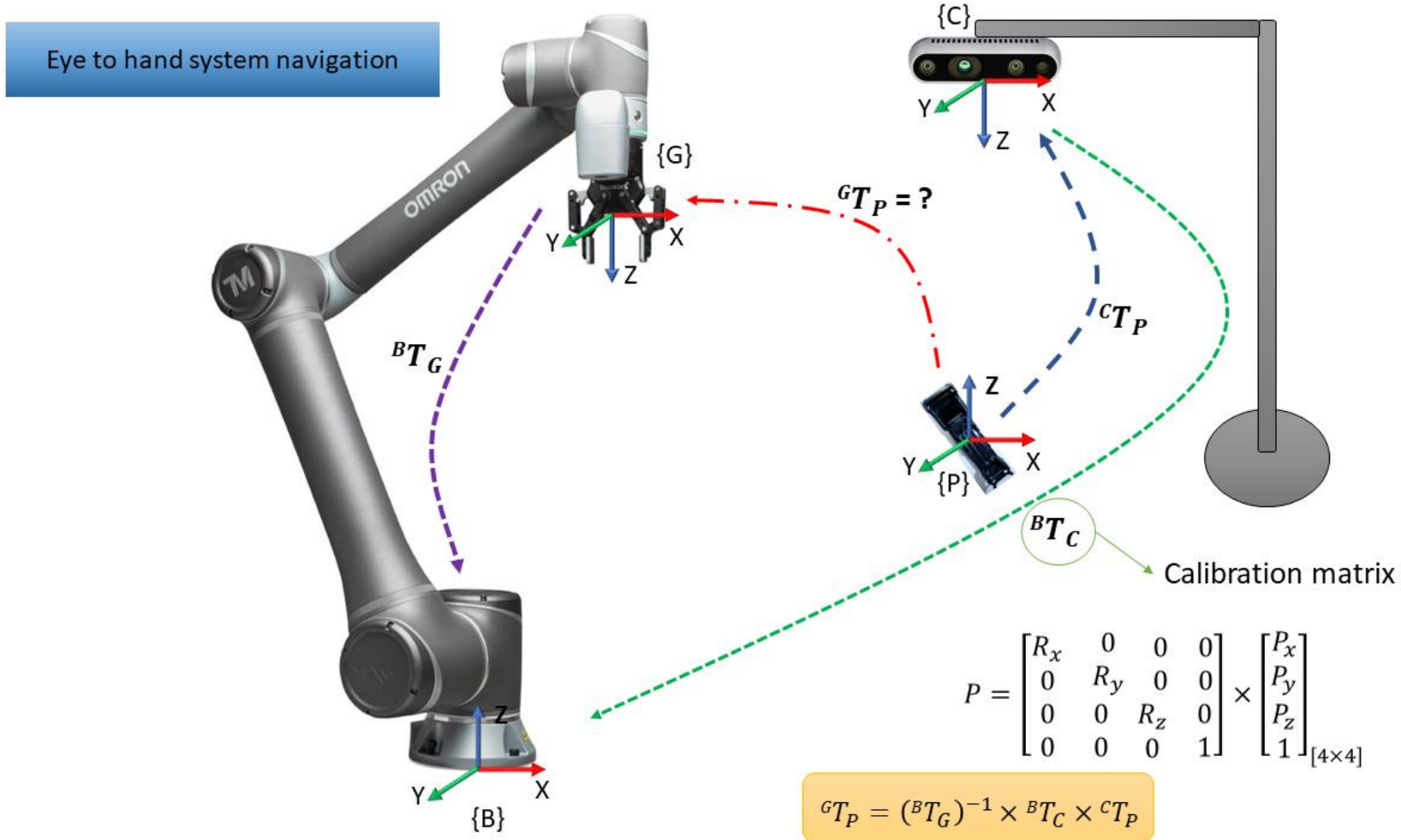
AGILE Demonstrator 3

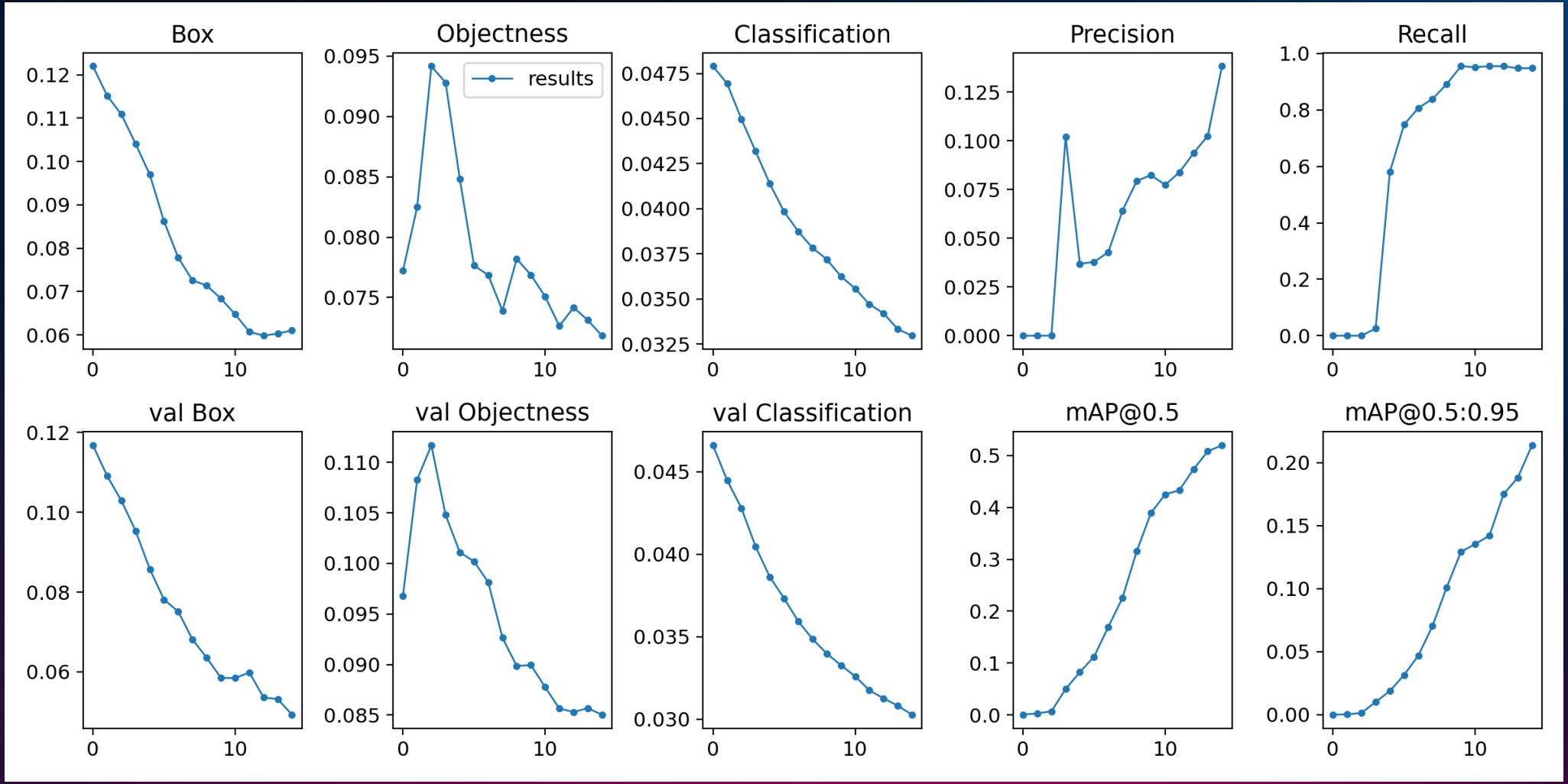
- Synchronizing different system coordinates



AGILE Demonstrator 3

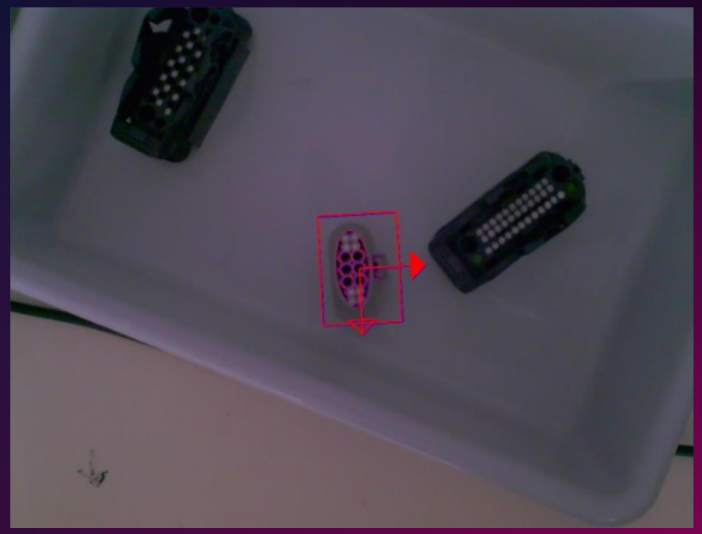
- Object (connector) recognition and classification using:
  - Intel Real-Sense (3D vision / depth)
  - Robot arm camera (positioning)
  - YOLOv5 with Pytorch

AGILE Demonstrator 3



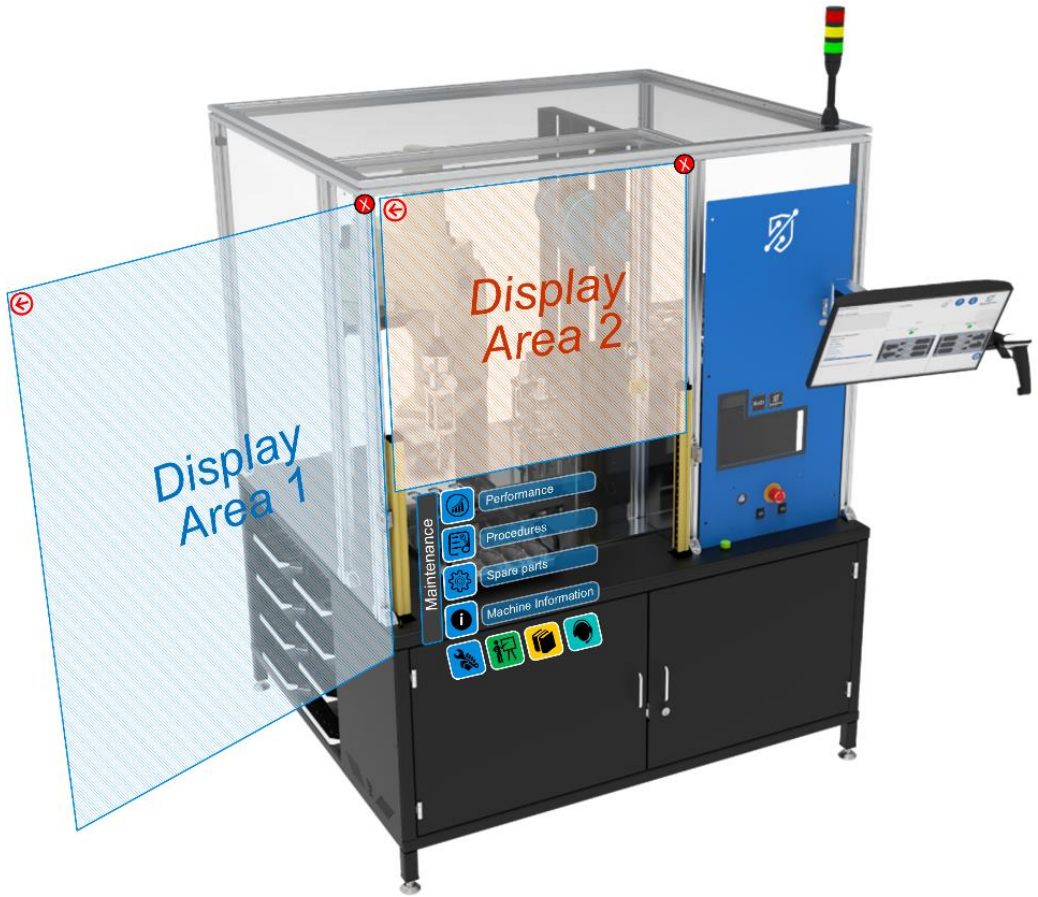
AGILE Demonstrator 3

- Next steps
  - Improve the speed of the robot
  - Improve recognition of object orientation

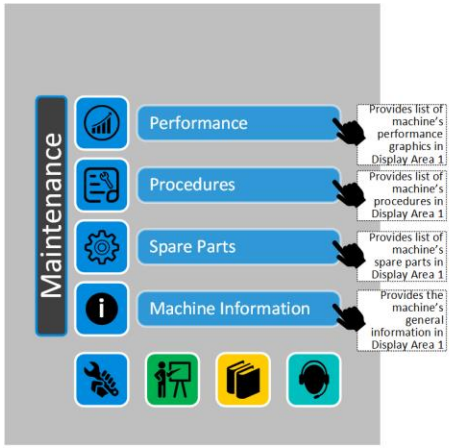


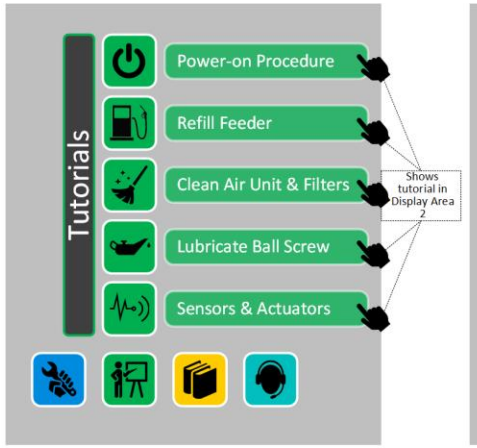
AGILE Demonstrator 2

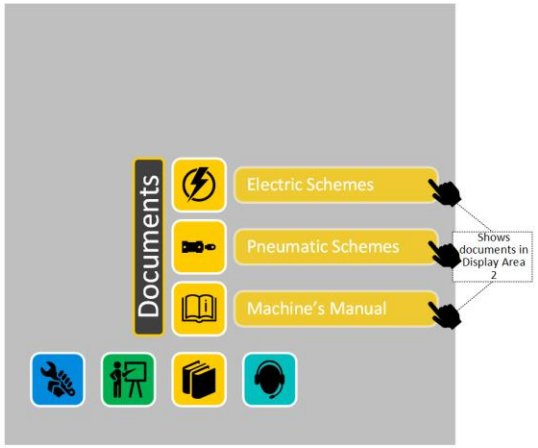
HRI through Augmented Reality

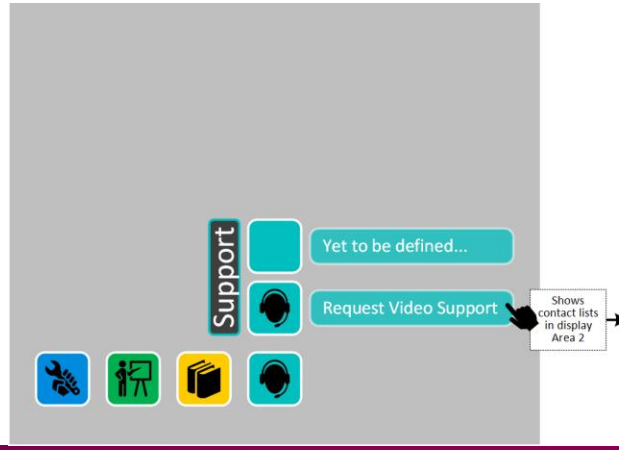


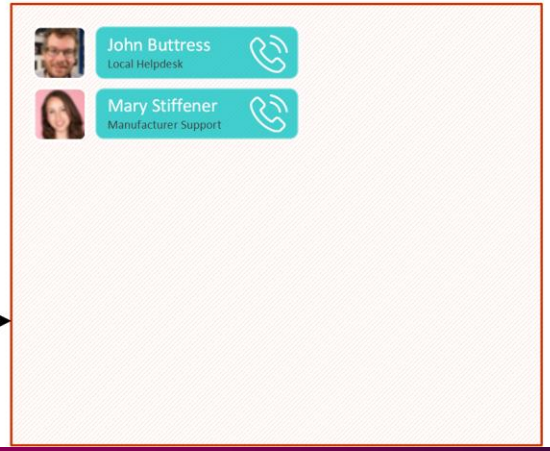
Navigation system – AR capabilities





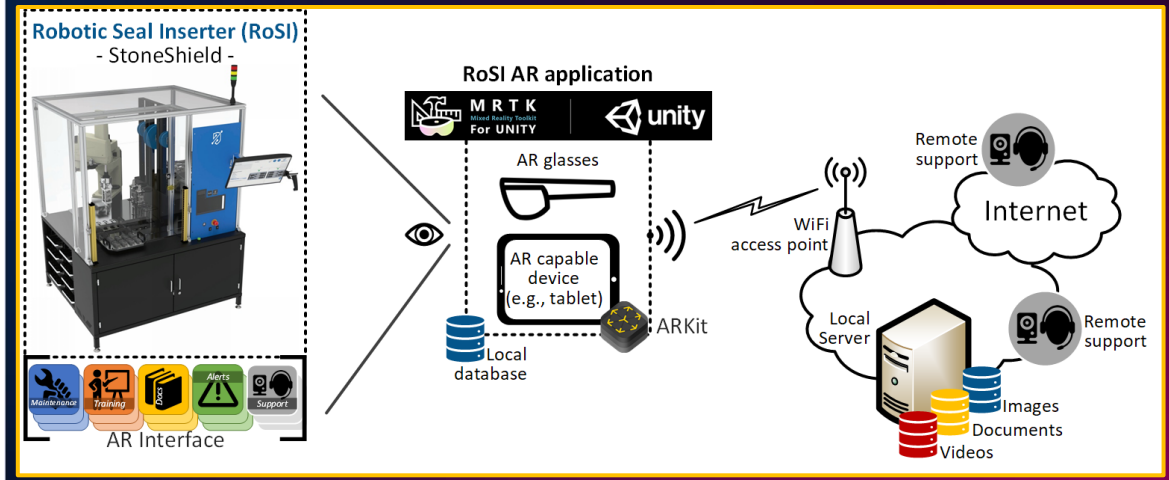


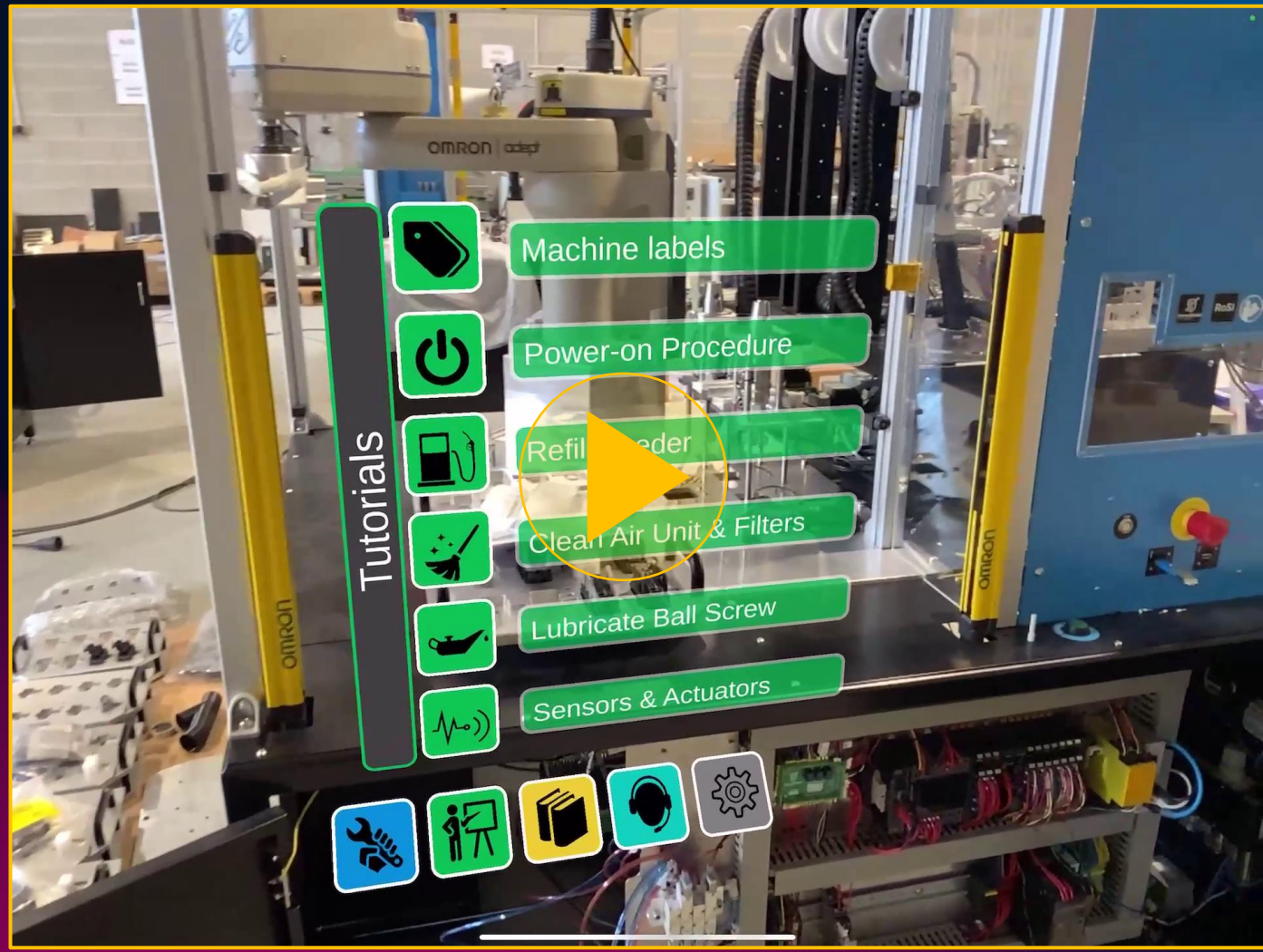




AGILE Demonstrator 2

- Next steps
  - Complete the remote video support functionality





Final Remarks

- TRINITY has provided us with expertise in different domains:
  - Inspiration for the Use cases
    - 3 Use Cases have direct match with our interests
    - These are very well documented and facilitate adoption
  - Valuable feedback in different areas
    - Collaborative assembly with vision-based safety system
    - Human-Robot Interaction guidelines
    - AI and ML for object detection, recognition, classification and pick-up by a robotic arm
  - Collaborative Publications (upcoming)