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Reducing Human intervention using Extended reality

Objectives

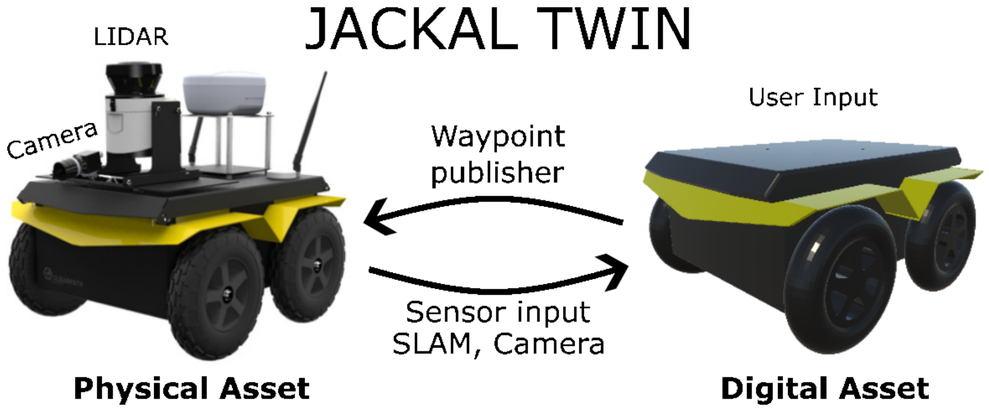
- Develop a HoloLens-based application for intuitive teleoperation of the Jackal robot.
- Train and assist inspection and maintenance tasks using knowledge of the digital representation and sensor data.

HoloLens 2

Introduction & Background

Inspection and maintenance of critical infrastructures, such as **offshore windfarms** and **nuclear** facilities, can pose significant risks and high costs.

Digital Twin (DT): A virtual replica of a physical asset or system, used to optimize and understand its physical counterpart.



Reality-Virtuality (RV) Continuum: The varying levels of immersion in virtual environments, spanning from real-world experiences to fully virtual ones:

- **Extent of World Knowledge (EWK):** Captured from **sensors.**
- **Coherence:** The emulation of the **digital world.**
- **Immersion:** Stage of the RV continuum.

Digital twin of **autonomous robots** and **facility** in combination with **XR** is advantageous for inspection and training:

Inspection:

Economical: No transport cost with remote inspections.

Effective: One operator can control multiple robots at once.

Failure Prevention: EWK and coherence can predict errors.

Assisted Inspection: Useful information provided to user.

Training

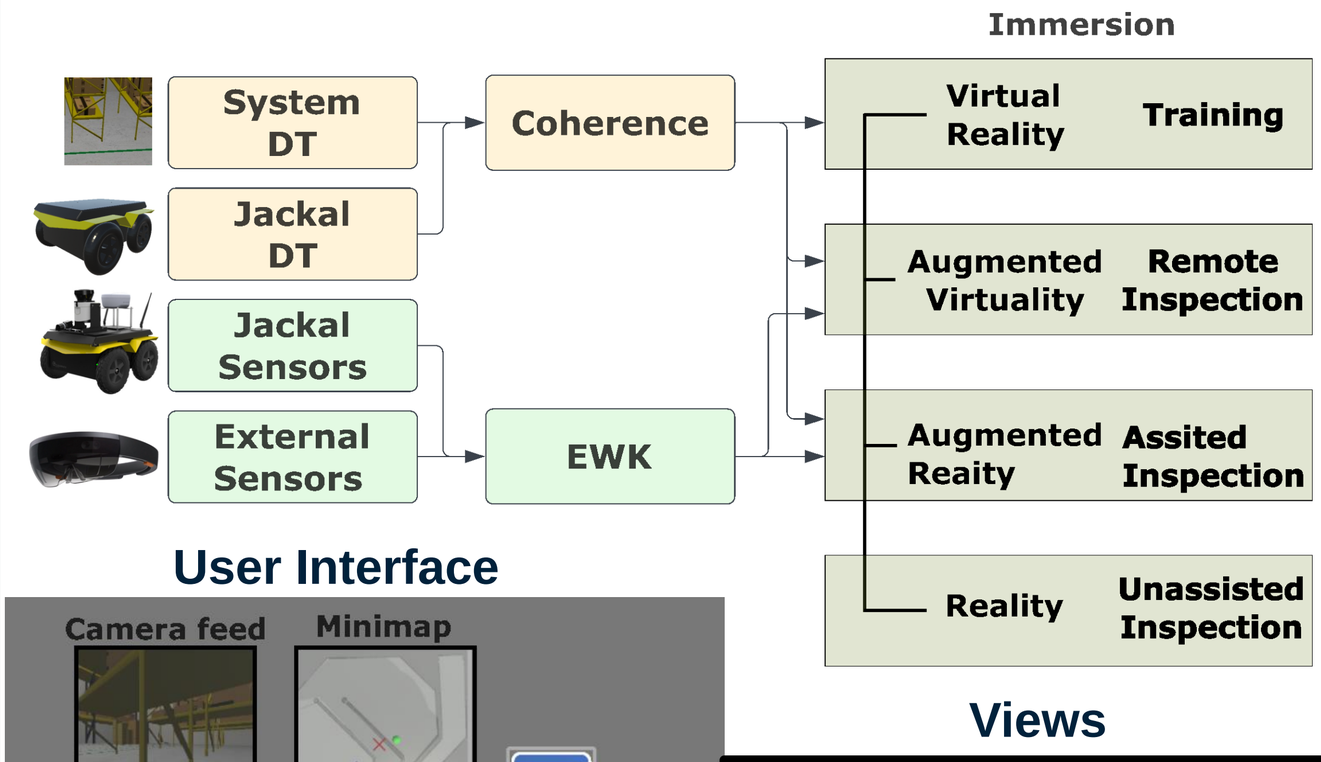
Immersive: Engaging and realistic training environments that can help learners better understand and retain information.

Safe and Controlled: Risk-free virtual environment.

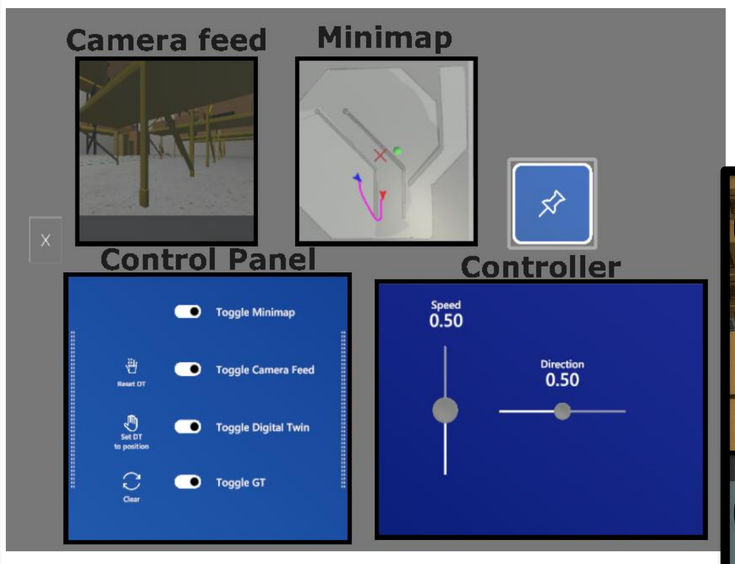
Adaptability: Adjustable difficulty.

Cost-effective: Expensive equipment not required.

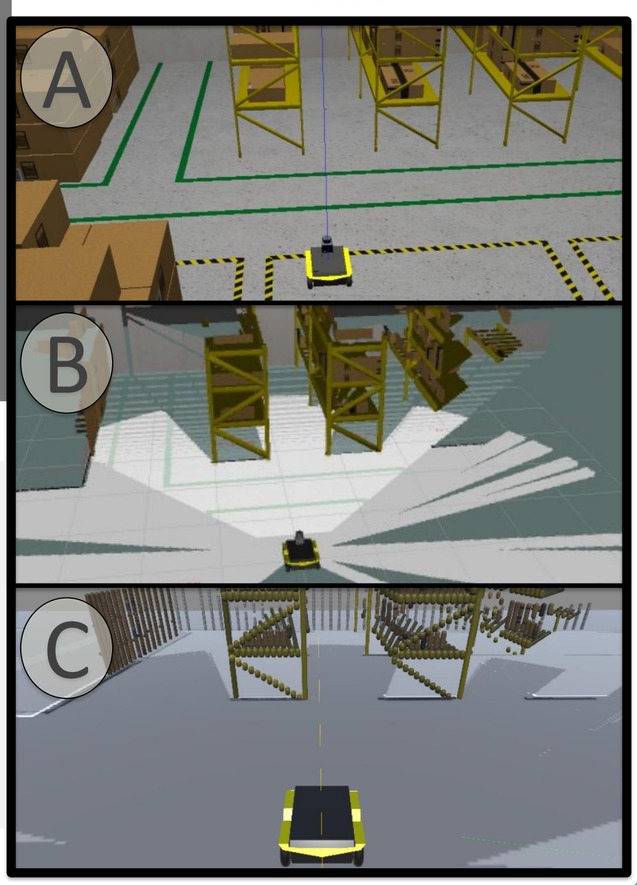
Methodology and Implementation



User Interface



Views



The robot is set into the environment, real or simulated **(A)**.

The sensor data is collected by the robot **(B)** and the HoloLens.

This information is aggregated into the AR environment **(C).**

Conclusion

The HoloLens application provided an immersive, safe, and controlled environment for training purposes.

Assisted inspection tasks were made possible by using sensor data and a digital twin representation.

Results

Successfully **visualized Sensor data** in AR environment.

Successfully **controlled Jackal robot** using HoloLens as input.

Future Work

Generating a DT of facility from stereo camera and 3D Lidar.

Increased robustness in control strategy as hand tracking can be unreliable.

Controlling multiple Robots at once using top level control of a robot fleet.