Developing Robotics, Artificial Intelligence and Autonomous Systems for the Offshore Sector

David Wavell
Business Development

VISION:

To support a long-term offshore industry vision for autonomous and semi-autonomous offshore energy fields; operated, inspected and maintained from shore.
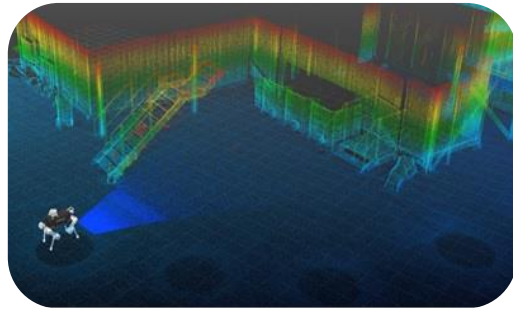
MISSION:

1. To translate the ORCA Hub top science into commercial products and services.

2. To support making the UK Supply Chain the most **productive** in the world.

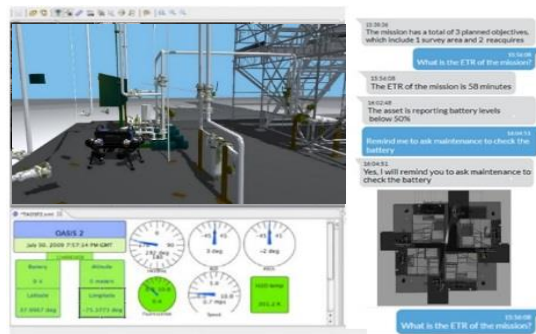# Advancing Innovation Through Collaboration
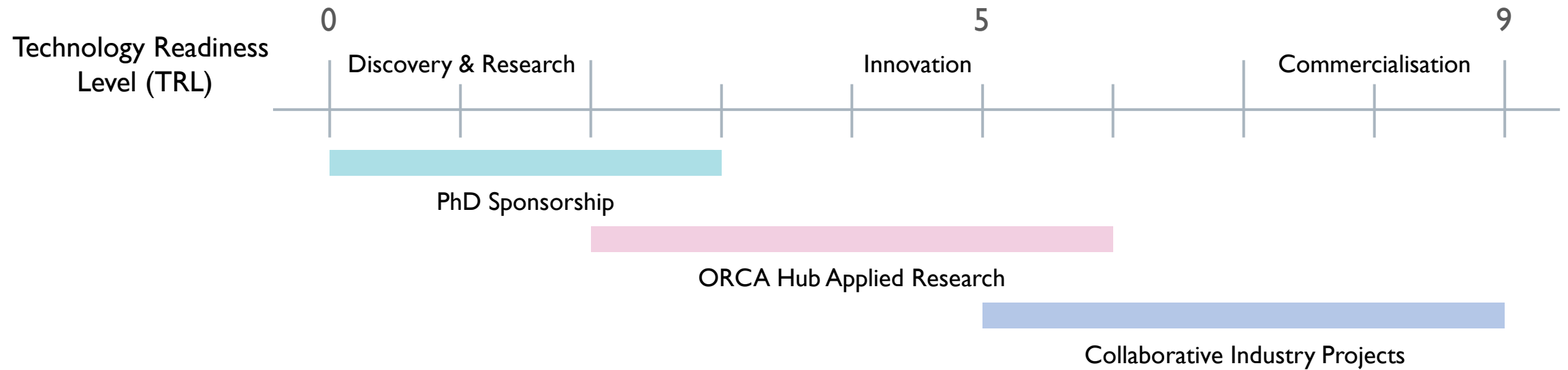
ORCA Research Areas

Mapping, Surveying and Inspection

Planning, Control and Manipulation

Intelligent Human-Robot Interaction/XAI

Robot and Asset Self-Certification

Mapping, Surveying and Inspection

- Using robots and teams of robots in air, land and sea to map, survey and inspect hazardous offshore environments.

- Includes:
  - The improvement of robotic mapping systems
  - Robot localisation
  - Real-time subsea 3D reconstruction & modelling
  - Autonomous environment mapping
  - Sensor networks
  - Robotics IoT
  - ATEX certifiable robot mountable NDE platform
  - Navigation techniques for GPS denied environments

- Sensing & mapping as an enabler for robot operations, and asset management & certification.

- Led by Professor Yvan Petillot at Heriot-Watt University.

Mapping, Surveying and Inspection
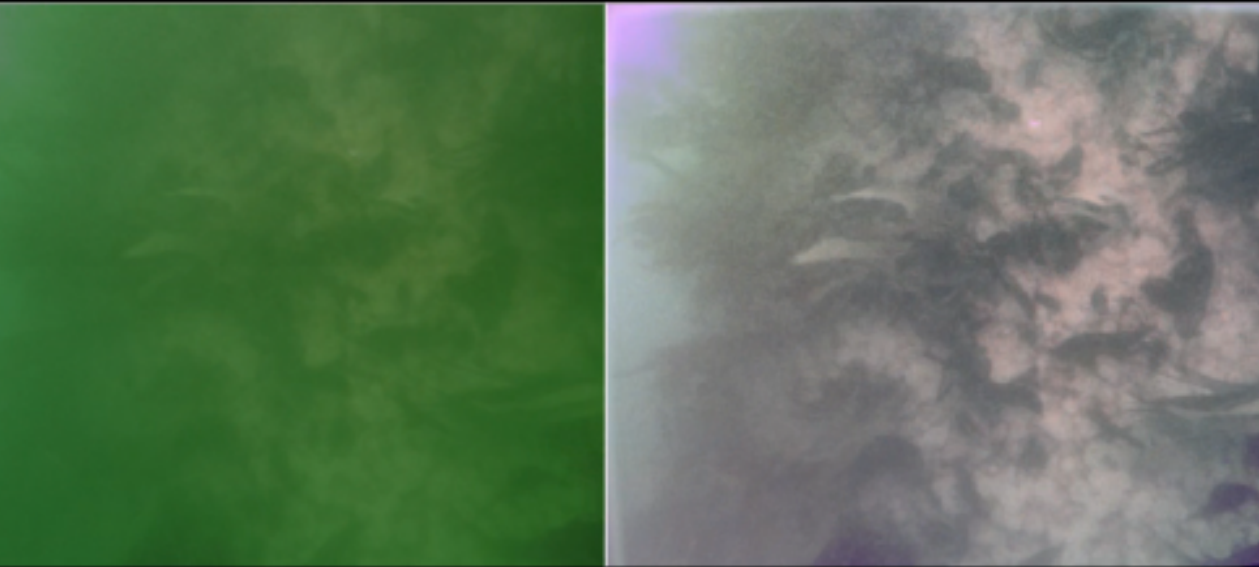
Image Enhancement	High Level Mission Planning for AUV Inspection
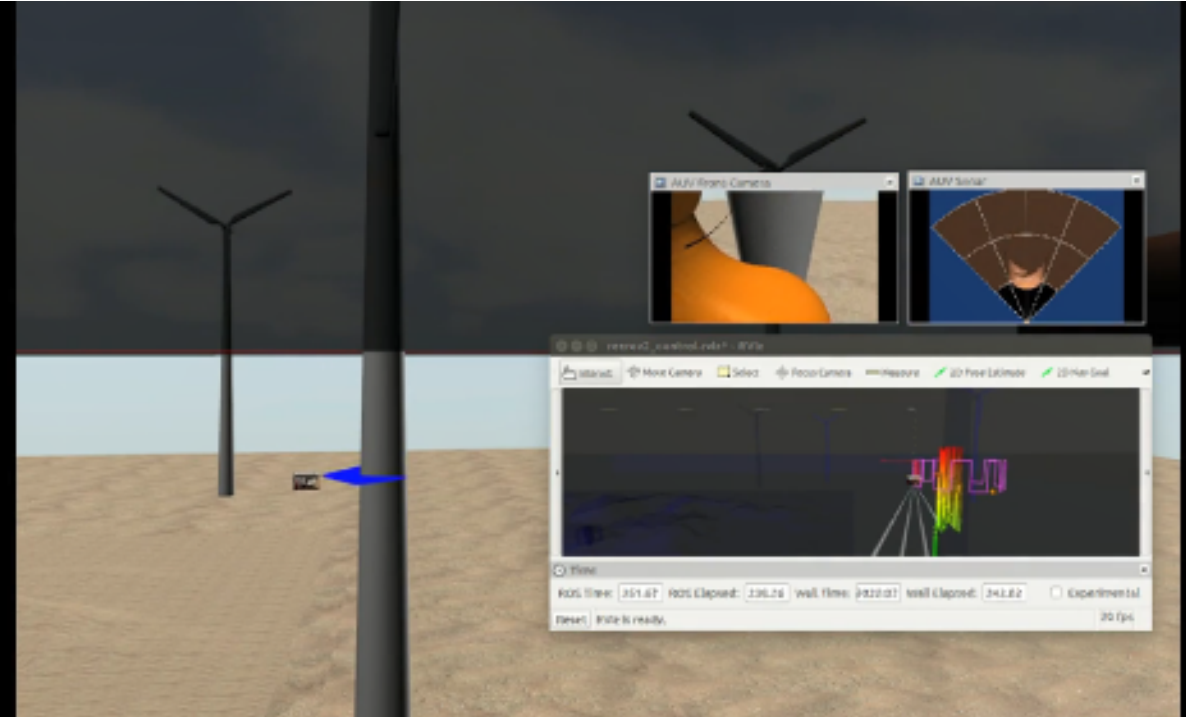
# Planning, Control and Manipulation

- The physical movement of robots around hazardous offshore environments in air, land and sea.

- Includes:
  - How robots moving on & around cluttered & hazardous environments – planning in dynamic environments, autonomous footstep planning, etc.
  - Adaptive motion planning
  - Shared autonomy (human-in-the-loop control)
  - Robot failure prediction, re-planning & recovery
  - Placement of sensors
  - Robotic interaction & manipulation with environment (surface & subsea)
  - Controllability & station-keeping of autonomous vehicles
  - Mission planning

- Led by Dr. Michael Mistry, Reader in Robotics at University of Edinburgh.

Planning, Control and Manipulation

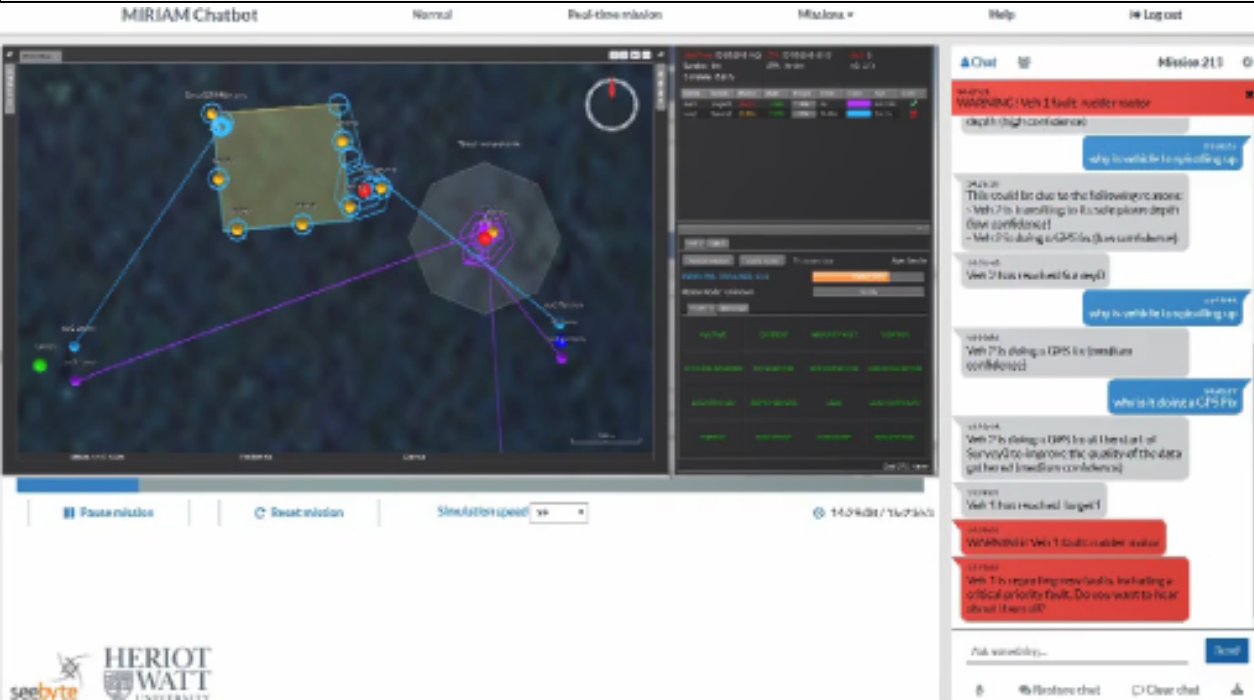| Autonomous Structure Interaction in Dynamic Environments	Autonomous UAV Perching for Contact-Based Inspection & Repair
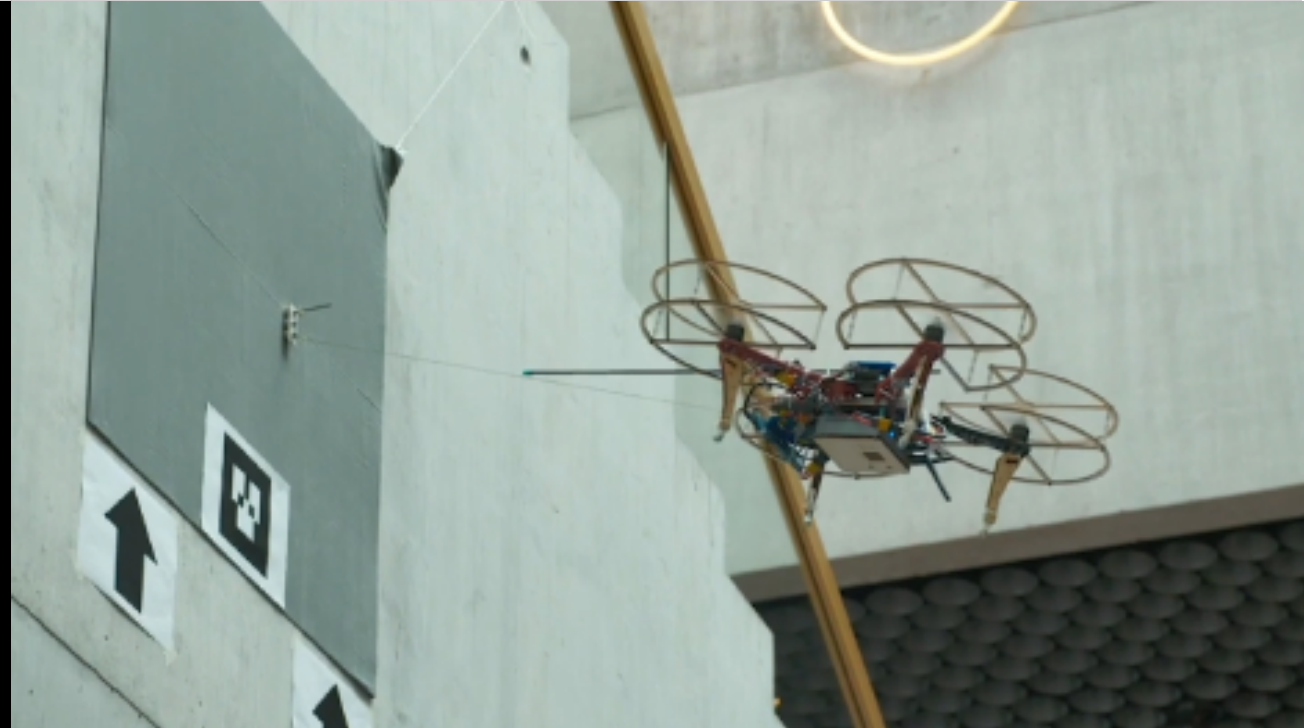
Intelligent Human-Robot Interaction with Explainable AI

- How robots and humans interact with each other to successfully carry out missions together with the correct levels of human situational awareness.

- Interfaces that support <u>joint human-machine decision-making</u> and <u>maintain the appropriate level of trust</u> through in-mission interaction:
    - Clear reporting/monitoring "what are you doing/where are you?"
    - Explainable AI & autonomy "why did you do that?"
    - Explaining the environment "what do you see/sense?"
    - Post-mission reporting

- Commands in natural language.

- Led by Professor Helen Hastie, Professor of Computer Science at Heriot-Watt University.

Intelligent Human-Robot Interaction with Explainable AI
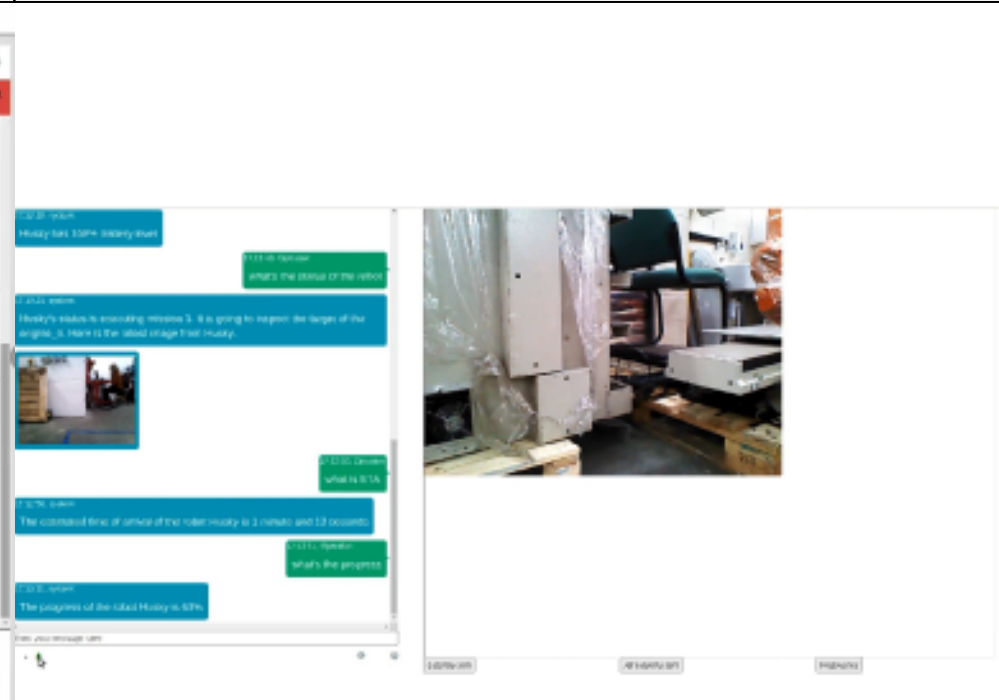
MIRIAM: Multimodal Intelligent Interaction for Autonomous Systems	Total Jarvis Project

Robot and Asset Self-Certification

Autonomy Verification and Validation University of Liverpool	Prognostic Health Management Software Reliability Heriot-Watt University	Data Analysis Machine Learning University of Edinburgh

- Developing and testing a practical self-certification methodology for robot and autonomous systems, and certification of self-learning robotic systems.

- Includes:
  - Developing a methodology for self-certifying autonomous robots carrying out asset certification
  - The certification of self-learning robots
  - Self-diagnosis of faults & self-healing
  - Prognostics for Robotic and Artificial Intelligence (RAI) operation reliability

- Led by Professor David Flynn at Heriot-Watt University.

Digital Twin

Augmented Reality - Offsite Inspection
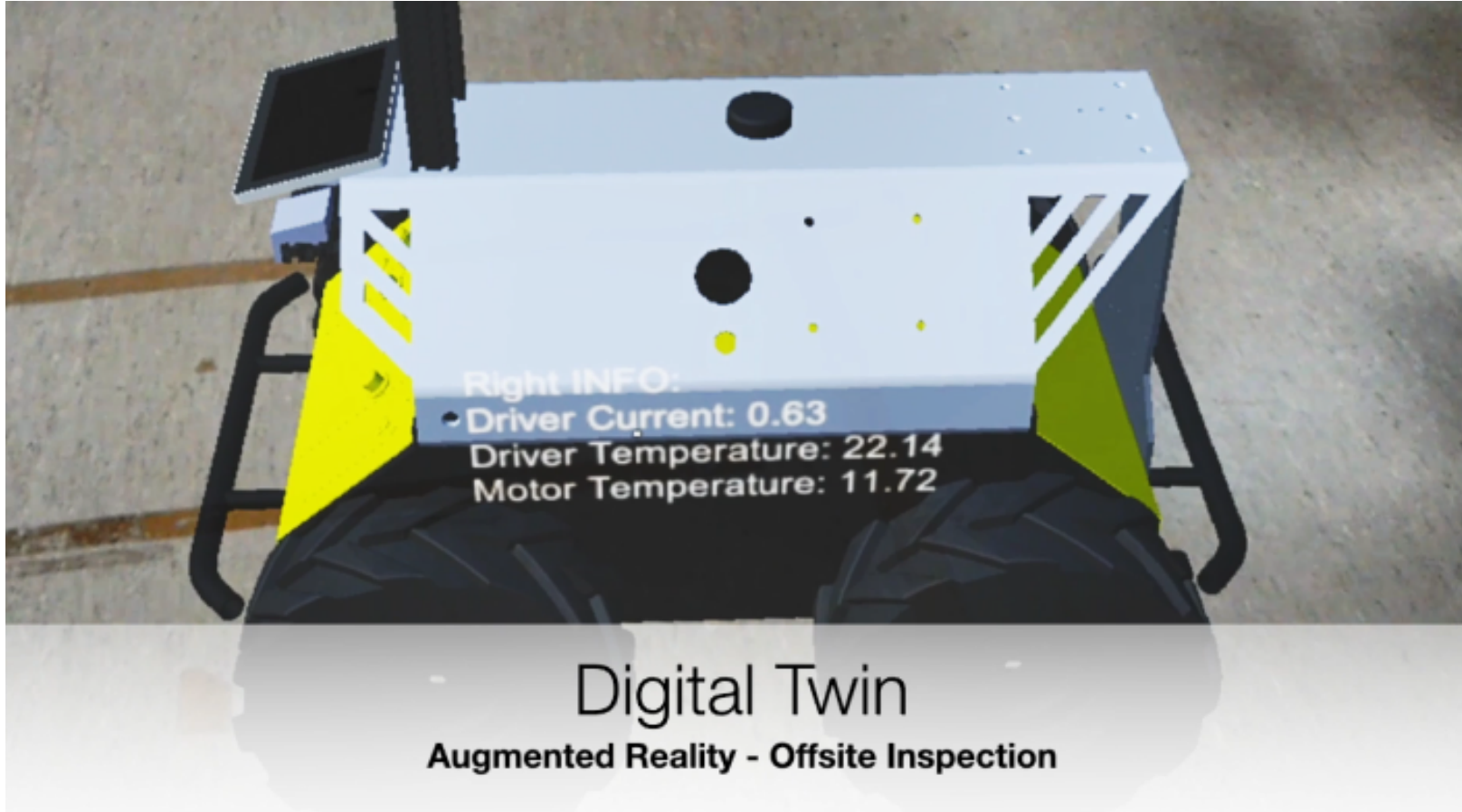
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