



SUPER – Stuttgart University Program for Experiencing Research Project Information

Institute's Information

Name of Institute Institute of Industrial Automation and Software Engineering
Contact Person Peter Frank
Phone +49 711 685 67294
e-mail Peter.frank@ias.uni-stuttgart

Duration of Project/Number of Students

June/July _____
June/July/August 1
Number of Students 1

Name of Project Automated Inspection and Maintenance with Legged Robots

Beneficial Skills & Knowledge

Experience with Robotics (ROS/ROS2), Object Detection, LLMs or VLMs
Beneficial, Robotic simulation tools (Gazebo, Isaac Sim),

Description of Work

Industrial inspection and maintenance tasks are still predominantly performed by human specialists, which results in high operational costs and exposes workers to hazardous environments. Recent advancements in artificial intelligence and robotics are making the deployment of legged robots, such as humanoids and quadrupeds, increasingly feasible for automated inspection and basic maintenance tasks. Their ability to navigate complex terrain and operate in environments designed for humans offers the potential to reduce the workload on human personnel, improve worker and operational safety, and ultimately lower overall maintenance expenses.

Autonomous robots for inspection and maintenance in industrial environments need more than basic visual detection only. They must understand how a facility is structured and how its components work together. Industrial plants such as offshore platforms contain many similar-looking valves, sensors and operating elements, and a purely camera-based approach often fails to distinguish them. Human workers rely on additional information, for example P&ID diagrams or manuals, which describe the function and relationships of these components. Giving robots access to similar sources of domain knowledge is therefore essential for reliable identification and interpretation.

This project focuses on developing an object recognition algorithm for a mobile robot in a simulated offshore facility. The system combines camera-based perception with information extracted from P&ID



diagrams. Instead of classifying components based only on their appearance, the robot uses structural and functional details from plant documentation to interpret what it observes. This additional context allows it to correctly identify elements such as measurement points, operating devices and other relevant components, even when they look alike.

The simulation environment Isaac Sim offers a realistic yet controlled environment that allows modelling the complexity of an actual industrial system. Within this setting, the robot detects objects through its onboard sensors and refines their classification using knowledge gained from documentation, enabling a more meaningful understanding of the facility. As an optional extension, the developed algorithm can be deployed on an edge device and tested in a simplified physical test setup, allowing validation under real operating conditions and bridging the gap between simulation and practical application. To realize the system, modern hardware such as the Jetson Thor edge device or a Unitree quadruped is available.

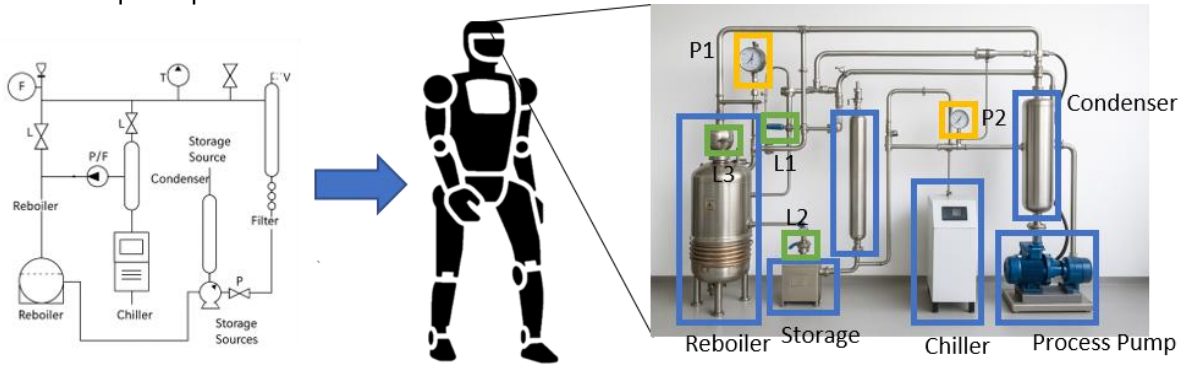


Fig. 1: Visualization of the approach

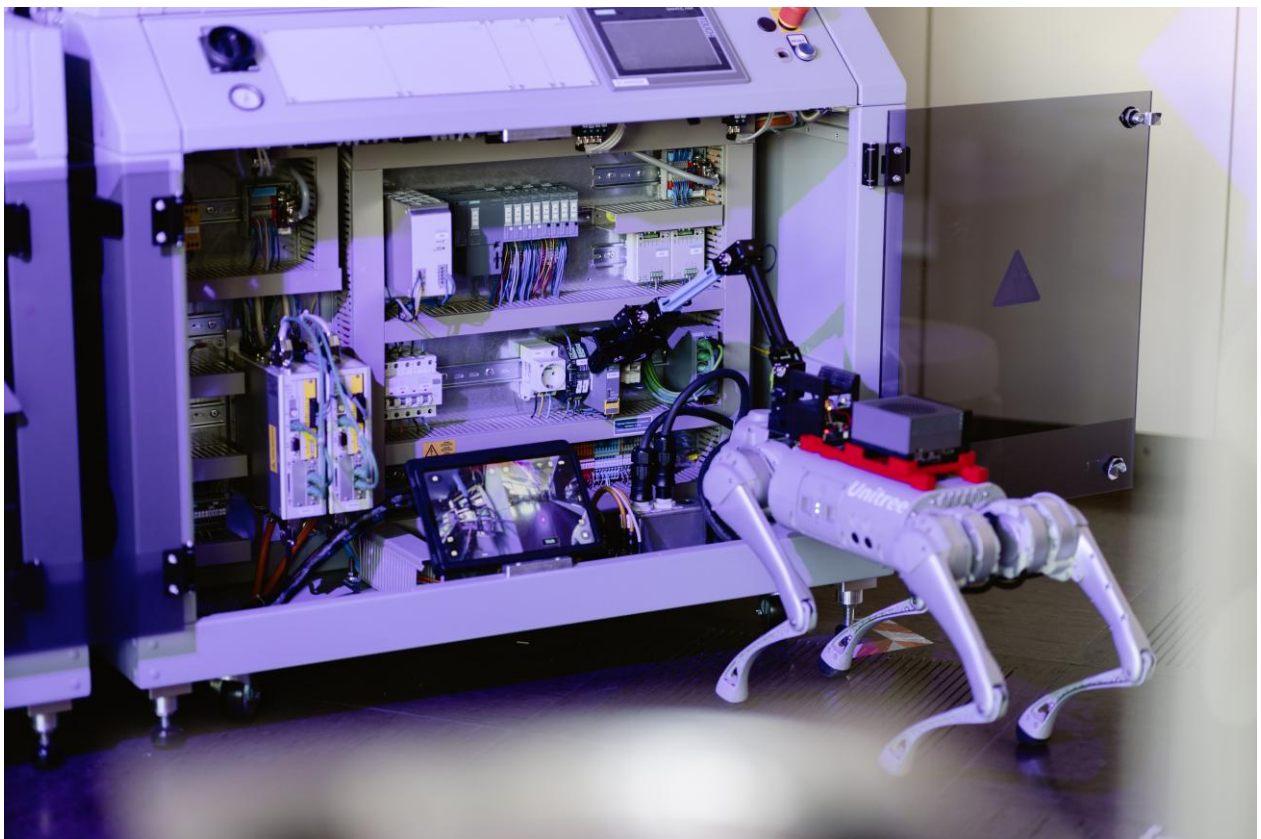


Fig. 2: Inspection and Maintenance with the Unitree Go1 at IAS

