JARVIS

DRIVING HUMAN-ROBOT COLLABORATION:

QUARK – Quality Assurance with Robotic Knowledge

Funded by the European Union

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QUARK – QUality Assurance with Robotic Knowledge

The QUARK pilot project is redefining quality inspection processes in the plastics industry by transforming operators into active collaborators with robotic systems through intuitive Augmented Reality (AR) interfaces and Artificial Intelligence.

The QUARK (QUality Assurance with Robotic Knowledge) pilot project is officially moving from architectural definition to technical realization. By transforming traditional inspection into a collaborative process, QUARK is redefining how operators interact with AI-driven robotics in the plastics industry.

Sprint 2 Progress: Overcoming Technical and Environmental Challenges
During the second Sprint, the team transitioned from theoretical workflows to offline testing and hardware optimization. Significant strides were made in tailoring the JARVIS tools to the specific needs of the GERMANPLAST production floor.

We have successfully validated the AR Interfaces tool, focusing on real-time visualization of inspection results and defect overlays. To ensure maximum usability on-site, we implemented several key updates:

- Standard projector installations were unfeasible due to factory lighting conditions and distance constraints. To address this, the project has pivoted from a fixed projector to an industrial monitor mounted on a mobile support. This solution significantly improves the workflow by bringing critical system information, such as errors and alarms, directly to the point of interaction, thereby reducing cognitive and operational strain for the operators.
- Localization: The interface is now fully in Italian to facilitate seamless adoption by local operators.
- Visual Clarity: We replaced standard status indicators with pie charts for box-filling monitoring, providing a more intuitive at-a-glance status check.
- Synchronization: We are utilizing ROSBAG files to simulate data transmission within our Dockerized environment. This ensures the vision system and AR feedback are perfectly synchronized before the physical deployment in Sprint 3.

One of the most critical components of the QUARK project is the Object Recognition and Pose Estimation tool. This module is essential for enabling the robotic system to accurately identify and locate plastic parts within the inspection cell, allowing for precise interaction and quality analysis.

During the integration phase in Sprint 2, we conducted extensive testing to validate the tool's performance based on the initial technical specifications. However, we encountered significant implementation challenges related to hardware constraints:

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- GPU Memory Bottleneck: our initial test environment, equipped with a 12GB GPU, proved insufficient. High memory utilization by the Object Recognition tool led to stability issues, preventing the system from reaching the required inference rates.

- Transition from a RealSense-based setup to an Ensenso camera system, in collaboration with JARVIS team, to ensure higher precision in detecting complex plastic geometries.

We are pleased to report that after a strategic hardware upgrade—configuring a second, more powerful PC with an optimized GPU—the implementation issues have been resolved. The tool is now operational and successfully tested.

QUARK project fully aligns with the JARVIS mission by successfully integrating AR Interfaces and Object Recognition & Pose Estimation tools within our robotic inspection cell. This integration brings significant value by enabling faster reconfiguration and allowing operators to interact with the system and provide real-time feedback without needing programming skills. We are currently conducting real-world deployment and usability studies with GERMANPLAST personnel. JARVIS mentoring and support have been pivotal during these activities, helping us optimize our interoperable ROS2-based framework and guiding our progress toward the final TRL 7 validation

The success of this phase is rooted in the close collaboration with the JARVIS consortium. Technical exchange has allowed for rapid file sharing and the resolution of interoperability issues between different ROS2 distributions (Jazzy and Humble) using a container strategy. Constant contact with the JARVIS technical team ensured that any issues arising during this phase were resolved quickly and efficiently. Finally, the JARVIS network has significantly increased the visibility of QUARK's results, amplifying our dissemination efforts and allowing us to reach a broader audience within the smart manufacturing sector.

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