Seamless Human-Robot Interaction through a Distributed Zero-Trust Architecture and Advanced User Interfaces

Alessandro Peretti[1], Matteo Mazzola[1], Luca Capra[1], Marco Piazzola[1], Cristiano Carlevaro[1]

[1] *Spindox Labs S.R.L. 38123 Trento (TN), Italy*

State of the Art

Nowadays, robots can handle complex tasks, posing challenges in their development, deployment, and usage. Human-Robot Collaboration (HRC) and Robot-Robot Collaboration (RRC) have become pivotal in Industry 4.0, where autonomous systems enhance productivity, safety, and quality. Security measures like Zero Trust Architecture (ZTA) ensure interactions are authenticated and authorized. Large Language Models (LLMs) play a key role in robotics innovation, utilizing their language understanding and generation capabilities. LLMs enable autonomous agents to perform tasks, make decisions, and interact with environments akin to hum ans, thus enhancing automation processes significantly.

Aim

The proposed work aims to simplify interactions between humans and robots by introducing an innovative IT interface. A virtual avatar acts as an intermediary, extracting operations from the company's knowledge base and translating them into actionable instructions for robots.

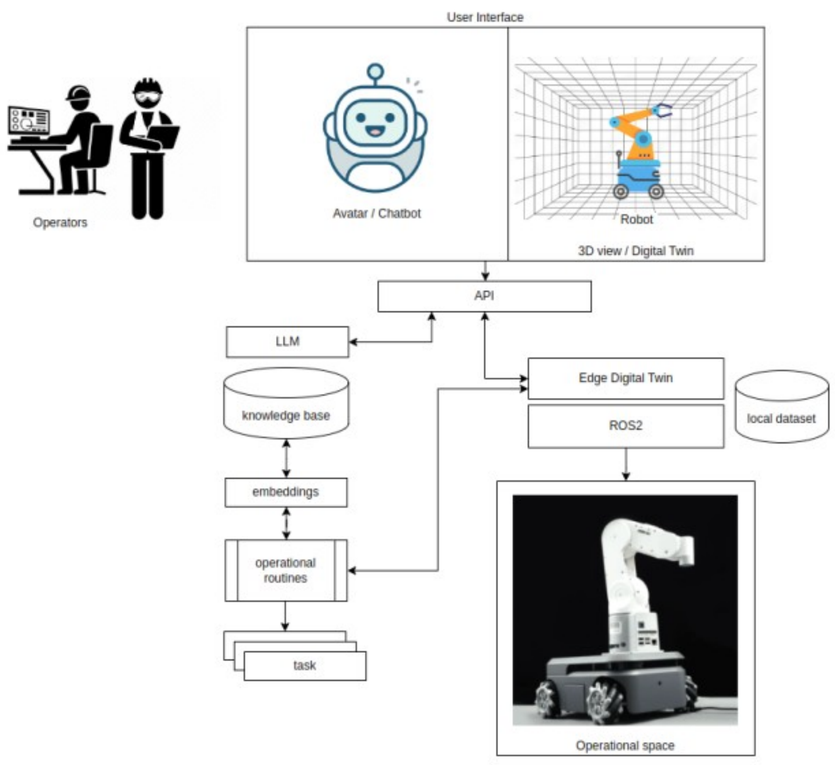

Figure 1. System Architecture.

Users can interact with the avatar naturally, enabling non-skilled workers to engage in HRC. The avatar leverages LLMs to interpret operations and communicate them effectively. A Graphical User Interface (GUI) provides real-time visualization of robot systems, utilizing Extended Reality (XR) for immersive experiences. Digital twins of robots, integrated with the Robot Operating System 2 (ROS2), enable precise task execution and adaptability to dynamic environments. This platform aims to democratize access to advanced automation technology, making it user-friendly and accessible across industries.

Got a question? Ask us or get in touch
info@sermasproject.eu

Results

The integration of a distributed zero-trust architecture, virtual avatar, and digital twins of robots has revolutionized human-robot interaction. The platform significantly lowers barriers for non-skilled workers, providing intuitive control over complex robotic systems.

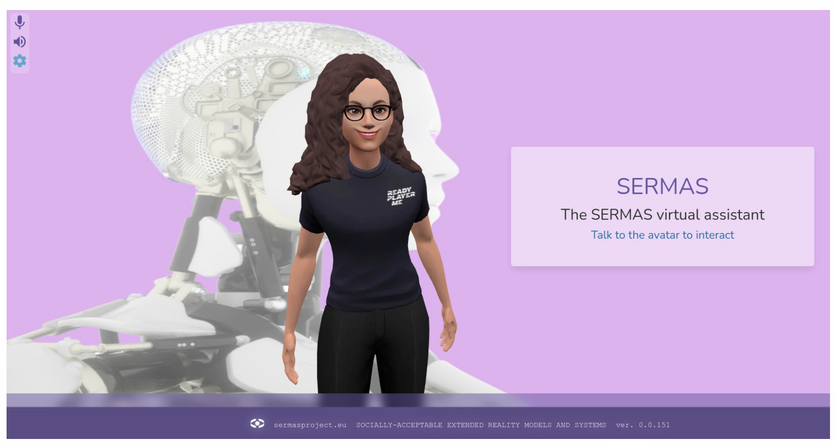

Figure 2. User Interface: system Avatar.

Figure 3. Elephant Robotics robot.

XR and natural language interfaces enhance user experiences, accommodating individuals with varying technical expertise. Consequently, the platform addresses the shortage of skilled workers by democratizing automation technology. Its implementation marks a groundbreaking advancement in human-robot collaboration, potentially transforming the landscape of automation and robotics in the workforce.

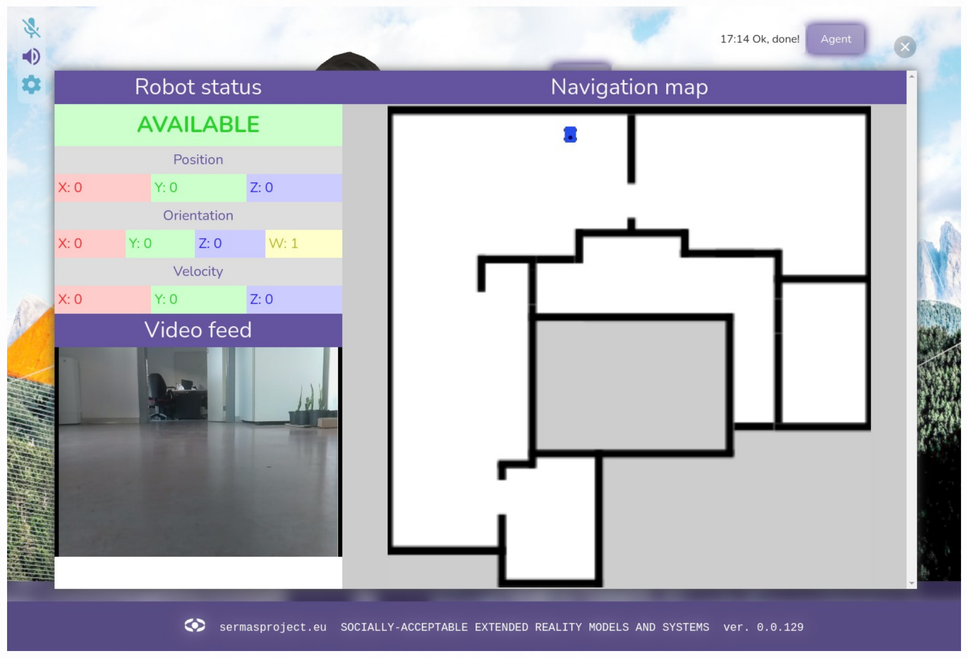

Figure 4. Robot status, real time position and orientation with navigation map as well as real time camera stream.

Scan Me!

Do you want to try our Avatar?

This work is based upon and motivated by the ongoing work on the Sermas project
Grant agreement ID: 101070351(https://sermasproject.eu/)

Funded by the European Union