

# Distributed intelligent production involving remote actors

## Basic Information

Project ID: AEE-2020-13

Students: Panu Salo, Niko Karhula, Juhani Lähde, Minh Duc Pham, Paavo Kajola

Project manager: Juhani Lähde

Instructor: Ronal Bejarano Rodriguez

Other advisors: -

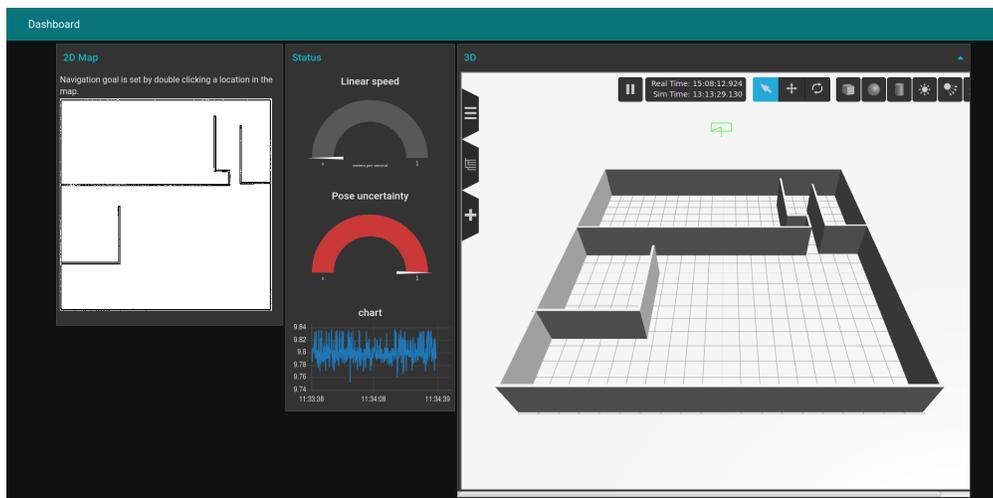
Starting date: 16.1.2020

Completion date: 28.5.2020

The ELEC-E8004 Project Work is designed to give a team of Master's students a practical team-working environment while solving an automation challenge. The project was based in the Aalto Factory of the Future (AFoF) and in close cooperation with VX Lab in RMIT Australia. This project's purpose was originally to successfully utilize a MiR100 robot in a controlled manner while further implementing simulation possibility and secure a remote setup for interconnectivity and interoperability despite the geographical differences.

Normally the stationed manufacturing sites are being operated on-site with the compulsory presence of the operator. With the use of the open-source platform ROS (Robot Operating System), Gazebo simulator, OpenVPN and their supported distributed environment, this project introduces an innovative and flexible way to the manufacturing floor when it enables remote manipulation of AGVs without direct contact. Moreover, this solution requires little to none changes in the factory infrastructure and ready-to-be embedded into the available resources.

Due to covid-19, the physical MiR100 component in the lab was replaced by a simulation environment based on ROS, Gazebo, made by DFKI. The simulated MiR100 robot was localized and navigated in a static premade environment. The user and the robot are communicating locally through Gazebo and RViz interface or remotely through a web interface. The user provides the robot with missions while the robot returns the map data and the robot's operating parameters. Since ROS can only be installed on a few specific operating systems, the use of virtual machines with Debian/Linux operating systems installed offered clients with no access to such OS can still involve in the project development.



Communication protocol posed as one of the main challenges regarding this project. Because of the aim to operate without borders, the Internet as the medium of connection is the only viable option to secure the integrity and confidentiality of communication. Network and latency tests have been carried out and analyzed in order to assess the stability and the throughput of signal.

**Project repository:**

<https://version.aalto.fi/gitlab/afof/distributed-intelligent-production-involving-remote-actors>

## References

[http://wiki.ros.org/mir\\_robot](http://wiki.ros.org/mir_robot)  
[https://github.com/dfki-ric/mir\\_robot](https://github.com/dfki-ric/mir_robot)  
<https://requests.readthedocs.io/en/master/>  
<https://restoreprivacy.com/openvpn-ipsec-wireguard-l2tp-ikev2-protocols/>  
[https://wiki.ros.org/rosbridge\\_suite](https://wiki.ros.org/rosbridge_suite)