



ROBO-PARTNER Project Newsletter Issue 6

March, 2017

MOTIVATION

Human skills are the main driver that enables producing high added value products in Europe. Thus the manufacturing processes are based on utilizing these skills. ROBO-PARTNER aspires the integration of the latest

industrial automation systems for assembly operations in combination with human capabilities, combining robot strength, velocity, predictability, repeatability and precision with human intelligence and skills.

Message from the Coordinator

Dear Readers,

In this final newsletter of ROBO-PARTNER project, it is time to sum up the progress from the initial idea generation to the upcoming closing meeting.

As a consortium, we had a big picture based on the requirements of the European industry in mind right even before the concept Industry 4.0 was released in 2013. Our major strategy was established on eliminating non-value added activities on the assembly operations in manufacturing, better use of human resources and resulting competitiveness. In this content, integrating humans and mid-and-high payloaded robots under a common, safe, ergonomic production environment would have played a great role. That would improve in ergonomic conditions in a flexible way for the aging society in Europe and could contribute in balancing gender equality on the shop floor. With the developing digital technologies, connectivity amongst humans, robots, manufacturing systems, peripherals and infrastructure would be possible. Operator 4.0's would be equipped with AR glasses to reduce the cognitive load and with wearable devices to command and feedback the manufacturing systems.

When it comes to end of the project, we see that we have provided outstanding efforts in realizing our imagination in three demonstration cases in the major driving sectors in Europe. In automotive case, one

hybrid cell has been implemented where humans and robot share the assembly tasks and work hand-to-hand when required. High physical load tasks are burdened by robots where humans supported by robots accomplish dexterous assemblies. Methodology was developed to classify assembly tasks as per interaction levels. Dynamic safety zones with respect to the robot working envelope, which allow further space for the operator, as well as guidance and command interfaces for humans such as AR glasses and smart watches were utilized for the needs of each assembly phase. In the white goods scenario, the major enabler for HRI is to avoid unsafe operations. The safety skin to support close human robot cooperation was integrated. To be valid for both mentioned scenarios, the IMAU concept, which stands for the 'intralogistics mobile assistant unit', is presented as a smart, autonomous and low cost solution for the logistics of the manufacturing parts within the plant. The heavy goods sector introduced the semi-autonomous overhead robot on the crane structure interacted with humans with follow-me and operator awareness functionalities. The planning software to design the hybrid human/robot cell was created which interprets ergonomic, financial and technical aspects. The communication is established on wireless systems with service oriented architecture and optimization software. ▼

COVER OF ROBO-PARTNER PROJECT SIXTH SEMESTER

ROBO-PARTNER 9th GA Meeting

On November 23rd, 2016, Tekniker, hosted the 9th General Assembly meeting of the ROBO-PARTNER project in Eibar, Spain. After a first day to present and discuss the project's developments and future directions, the second day, the 24th, was dedicated to a visit to Jatoman's facilities to assess the application case developments.



It was the opportunity to discuss the implementation of the demonstrators, and how close in terms of implementation and testing are the application scenarios to be ready. Also, there was a discussion about the implications and benefits of moving some those demonstrators to TOFAS's facilities, in Turkey, for the final review meeting of the project.

AUTOMATICA 2016

In Munich, Germany, the AUTOMATICA fair had its 2016 edition from June 21st to the 24th. LMS has set a joint booth presenting the project's latest results on human robot interaction, augmented reality based operator support and ROS based control and coordination of the execution in hybrid cells.



Our partners prioritized dissemination activities for the last period, attended at the distinguished conferences, published papers to lead later research and conducted in-house activities to deploy the know-how internally. The exploitable result list encourages us for further ideas within the same consortium structure. The process for the patent applications and IPR agreements is ongoing.

Beyond the tangible and software based outputs, most of which reached TRL6 and above, the networking between partners, cooperation for later project proposals and improved human capital in terms of quantity and quality may be considered the most valuable achievements of the project.

I hereby once more want to thank to all partners for their utmost dedication, outstanding efforts and innovative approaches to contribute in strong European economy, to the EU commission to support us with the valuable feedback and to all readers to follow us.

Is this the end for the project? Not really. After the closing meeting to be conducted in LMS, Patras, on the 15th March 2017, the demonstrators intend to demonstrate on their shop floor. This will lead further industrialization of the solutions.

So, to be continued...

Best Regards,

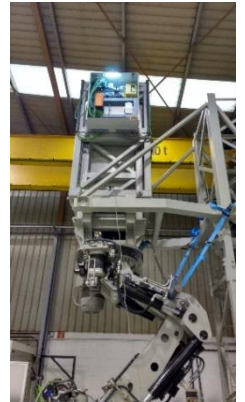
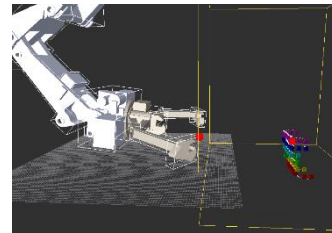
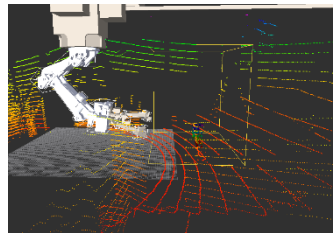
ROBO-PARTNER Coordinator

Progress

On the last semester of the 3rd year brought the ROBO-PARTNER's developments:

➡ On the Large Part Inspection scenario, the Hercules robot has been completely constructed and Tekniker has begun the first real-live experiments at Jatorman's facilities. The robot's and its payload size and mass offer many challenges to collision detection, namely detecting and tracking people under the load. A multitude of sensors were mounted specifically to provide autonomous operation capabilities.

Tekniker has also been developing the interaction mechanisms: "come to me" combining human detection and autonomous navigation or "collision risk detection" providing haptic feedback when collision risk arises.



➡ The Automotive Assembly use-case has had further developments on the IMAU robot. The adaptation design has been put to practice and the construction, wiring and assembly is reaching their final stages. The storage area is completed, with its 8-slot sensor-coupled structure. The support structure for the 6 degree of freedom manipulation system is nearly complete, with minor adjustments to the gripper being currently under development and construction. Safety mechanisms will be equipped last, as a new on site risk assessment is to be realized by PILZ, once an initial moving version of the system is assembled.

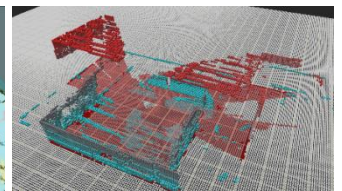
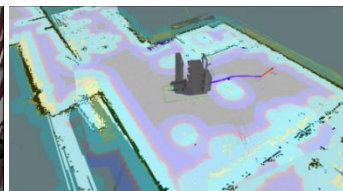
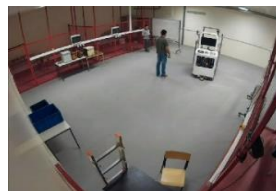
On the software side, there has been further developments on the perception modules (such as people tracking, obstacle detection and material box recognition and pose estimation) leading to the proposed shared mapping framework (on the left). Additionally, tests to the robot's navigation were conducted towards different parametrization profiles. On the right, the robot planning its path around an unexpected dynamic obstacle (human).



GROBOTICS OPEN HOUSE 2016



From November 11th, to the 13th, during Gizelis Robotics 2016 open house, the ROBO-PARTNER project had a booth displaying videos and distributing brochures to about 233 companies attending the event.



➡ The White Goods scenario set up has been almost concluded at LMS premises in Patras, where a prototype cell aiming to seal refrigerators parts, is now capable of integrating various functionalities and technologies to allow a safe Human-Robot collaboration at shop-floor level. The purpose for the next months is the fine tuning of the solution and the validation of the scenario including the KPI assessment and benefits calculation before the complete transfer of the cell to Electrolux factories.

The forthcoming months will be used to prepare the final demonstrators of the project's developments. The three use cases robotic solutions, met by PILZ's continuous risk assessment and performance evaluation will be put to the test in emulating real world scenarios.

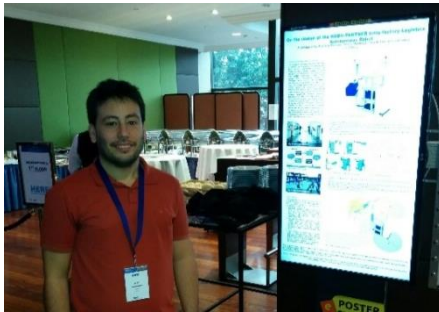
IEEE SMC 2016



The 2016 IEEE SMC edition was held in Budapest, Hungary, from October 9th to the 12th. UNINOVA had the opportunity to further disseminate early results of the ROBO-PARTNER project, namely developments on the Automotive Assembly intra-factory logistics mobile robot: the IMAU.

Two papers were presented during the conference. On October 10th, the paper entitled "Context-aware switching between localization methods for robust robot localization", featured in the *Robotic Systems* session, reported on flexible localization aided by context-awareness to be implemented on the IMAU.

The paper "On the design of the ROBO-PARTNER Intra-Factory Logistics Autonomous Robot" was presented on October 11th. The paper summed up the mechanical design: the adaptations to the base mobile platform; the storage area and the 6-DOF manipulation system. It also included the modular software architecture that embeds the IMAU robot, and implementation and testing of Task Planner integration.



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<http://www.robo-partner.eu/>

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EFFRA 2016

The European Factories of the Future Research Association (EFFRA) had its 2016 Conference in Brussels, Belgium, on September 15th (16th) gathering leading industrial and research experts to discuss the major priorities for the future of manufacturing in Europe. LMS made a pitch of project results to potential business and innovation partners as ROBO-PARTNER was among the key projects supported by FoF. The main questions involved such issues as safety technologies, the acceptance of operators and human considerations for ergonomics and the value of enabling industrial robots to work together with humans.



Factories of the Future
Conference 2016
Materialising Factories 4.0



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