

REPUBLIC OF SERBIA
MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGICAL DEVELOPMENT

compatible with basic requirements of the UbiCbot SME-suitable robotic technology + extensive experimentation and systematization of obtained experimental results

2.5. Development of the prototype of the industrial robust and dexterous/sensored multi-fingered robotic hand for bimanual robotic assembly, compatible with basic requirements of the UbiCbot SME-suitable robotic technology + extensive experimentation and systematization of obtained experimental results

Subproject title: **UbiCbot Technology Physical Demonstrations & Experimental Validation**

Ordinal number of subproject: **4**

Month of beginning of subproject (in the interval from 1 to 36): **7**

Month of completion of subproject (in the interval from 1 to 36): **30**

List of researchers who participate in the project realization:

1. Petar B. PETROVIĆ, MF, UBG, Serbia
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Subproject description (up to 2000 characters with spaces):

The general objective of the subproject SP4 is to provide practical validation of the developed technology within the subprojects SP2 and SP3, i.e., UbiCbot SME-suitable robotic technology in laboratory and eventually industrial environment. Activities that has to be carried out within this subproject will be clustered into two basic groups: 1) System integration activities and building physical robotic systems for selected application scenarios – the technology demonstration systems, and 2) Practical testing activities and validation of the technological performances of the demonstration systems. This project has particular importance for the overall projects, because participating companies of the project consortia should be deeply engaged, each of them having its particular role: 1) Company SOLE d.o.o., Kikinda, SERBIA will have the role of TECHNOLOGY DEMONSTRATOR and TECHNOLOGY USER by providing necessary financial resources which will enable physical realization and deployment of the collaborative, human-centric and Industry 4.0 compatible system for robotic welding of highly customized products, 2) Company MikroElektronika, Belgrade, SERBIA, will take a role of the TECHNOLOGY PROVIDER supplying the project consortia with Industry 4.0 compatible industrial ICT products/systems (tailor-made microcontroller based smart modules for control, sensing and communicating purposes), as well as with specific expertise in developing such kind of advanced systems, 3) EFORT Robotics Company, Wuhu, Anhui, CHINA, will take a role of the TECHNOLOGY PROVIDER supplying the project consortia with advanced robotic arms, including dedicated solutions which are developed following the basic requirements for the UbiCbot SME-suitable robotic

technology, and 4) Company Mikro-Kontrol d.o.o., Belgrade, SERBIA which will take a role of a SYSTEM INTEGRATOR, providing the consortia with a specific knowledge and expertise in building a complex factory automation systems, compatible with Industry 4.0 general requirements, as well as, more general, with the specific requirements of the Cyber-Physical Manufacturing Systems. The powerful bilateral cluster of industrial companies will guarantee that the research activities of this project are: 1) Industry driven, 2) Highly relevant for manufacturing industry of both countries, and 3) Practical applicability of the conducted research (truly from Lab-to-Market concept applied in practice).

The SP5 is reserved for physical demonstrations and experimental verification of two use cases.

- T 5.1 Building and functional testing of demonstration installation - use case #1
 - SME Suitable Collaborative Bimanual Robotic Assembly System, for experimental validation in laboratory conditions
- T 5.2 Building and functional testing of demonstration installation – use case #2
 - SME Suitable Collaborative Dual-arm Robotic Arc Welding System, for experimental validation in laboratory conditions.

Subproject objectives (up to 2000 characters with spaces):

The key objectives of this subproject is to: 1) Develop and physically realize innovative hybrid manufacturing systems based on the general concept of human-robot collaboration applying the UbiCbot SME-suitable robotic technology, and 2) Gain practical feedback from real-world applicative scenarios and thus provide valuable feedback for dominantly research subprojects, and based on that refine developed concept as well as developed theoretical background. Looking from the strategic point of view, taking into consideration competitive performances of manufacturing SMEs in both countries, the developed UbiCbot SME-suitable robotic technology, will pave the road for future research activities and transferring these activities into business as a a new paradigm of affordable and SME suitable human centered robotic technology, which optimally meets the requirements of SMEs in both countries, and which is furthermore compatible with Industry 4.0 standards. By experimental validation and physical demonstration of this technology, the project consortia should bi convinced that such technology fully satisfy the following set of the key/generative building blocks: a) High flexibility, far beyond conventional flexible/programmable automation, b) Human centric and human friendly, c) High autonomy and general behavior which can be classified as an industrial humanoid (first of all due to its cognitive performances and abilities), and d) Intelligent agent embedded into robot control system, allowing the robotic system to gain new knowledge and communicate with surrounding biological and engineered systems (human workers and robots)– the system will behave as an intelligent technological agent capable to: a) acquire and generalize skills from human worker(s), b) semantically analyze sensory data, recognize patterns and match them with nominal CAD and process data, and c) shares the knowledge of how to best perform the operation/task with other robots;

Task 1

Task name: **UbiCbot Robotic Platforms Building**

Task description (up to 500 characters with spaces):

The Task 1 will be focused on development and practical realization of two prototype robotics systems, for UbiCbot SME-suitable robotic technology validation in laboratory conditions. In fact, within this task two experimental platforms will be produced for two specific application scenarios:

Demonstration / Experimental platform #1 – SME Suitable Reconfigurable Collaborative Bimanual Robotic Assembly System, for experimental validation of the UbiCbot SME-suitable robotic technology in laboratory conditions, and

Demonstration / Experimental platform #2 – SME Suitable Collaborative Dual-arm Robotic Arc Welding System, for experimental validation of the UbiCbot SME-suitable robotic technology in laboratory conditions.

List of results:

1.1. Physical prototype of the Experimental platform #1 – SME Suitable Reconfigurable Collaborative Bimanual Robotic Assembly System – **UbiCbot RoboASSEMBLER**

1.2. Physical prototype of the Experimental platform #2 – SME Suitable Reconfigurable Collaborative Dual-arm Robotic Arc Welding System – **UbiCbot RoboWELDER**

1.3 Physical prototype of the industry compatible dexterous hand for bimanual assembly

NOTE: Both names: **UbiCbot RoboASSEMBLER** and **UbiCbot RoboWELDER** are trademarks of the CMSysLab and cannot be used without explicit permission of the CMSysLab!

Task 2

Task name: **UbiCbot Robotic Platforms Experimental Validation**

Task description (up to 500 characters with spaces):

This task will embrace a two group of activities: 1) Basic functional testing of the Experimental Platform #1 – UbiCbot RoboASSEMBLER and Experimental Platform #2 – UbiCbot RoboWELDER and 2) Detailed analysis and identification of technological performances, i.e., practical validation of the developed UbiCbot SME-suitable robotic technology in laboratory conditions, with possible extension of the UbiCbot RoboWELDER to real-world application scenario through its application in industrial SME environment.

List of results:

2.1. Report on identified performances of UbiCbot RoboASSEMBLER experimental platform

2.2. Report on identified performances of UbiCbot RoboWELDER experimental platform

2.3. General report on UbiCbot SME-suitable robotic technology validation in laboratory conditions and its technological readiness for further dissemination as a marketed product(s), i.e., UbiCbot SME-Suitable technology as a Serbian and Chinese commercial brand

Subproject title: **Dissemination**

Ordinal number of subproject: **5**