Highly customizable robotic solutions for effective and safe human robot collaboration in manufacturing applications

Rendicontazione

Informazioni relative al progetto

FourByThree

ID dell'accordo di sovvenzione: 637095

Sito web del progetto

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Progetto chiuso

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Questo progetto è apparso in...

Periodic Reporting for period 2 - FourByThree (Highly customizable robotic solutions for effective and safe human robot collaboration in manufacturing applications)

Periodo di rendicontazione: 2016-06-01 al 2017-11-30

Sintesi del contesto e degli obiettivi generali del progetto

Industrial robots have demonstrated their capacity to answer the needs of many industrial applications, offering a high degree of dexterity, accuracy and efficiency. However, when the application requires the collaboration between the robot and the worker, including workspace sharing, it is not feasible to use standard industrial robots due to safety being compromised
Over the last years, some robot arms have appeared on the marked claiming to be safe when used in the vicinity of humans. These robots offer good solutions for some specific applications offering the possibility to control the force exerted in case of collision, however they lack the flexibility (in terms of possible physical configurations) or are very expensive.
Furthermore, even these robots are offered as isolated products but offering rigid programming mechanisms and without rich perception capabilities or adequate responsive behaviours that have to be developed by the system integrators.
FourByThree has develop a set of components that help creating a new generation of modular industrial robotic solutions that are suitable for efficient task execution in collaboration with humans in a safe way and are easy to use and program by the factory worker.
As a result of the project, system-integrators have at their disposal a kit of hardware and software elements that allow creating the custom robotic solution that best fits their needs, including the robotic arm (actuators, links, electrical cabinet, control and programming software), interaction and safety mechanisms.
The results have been validated in four challenging industrial Pilot Studies (Aeronautic, Sheet metal forming, Investment casting and Professional training) addressing relevant applications (assembly, welding, deburring, riveting and machine tending).
As part of the validation, several experiments were performed in which more than one hundred

participants have tested, first-hand, the technologies providing interesting feedback on interaction and safety aspects as well as their perception on human-robot collaboration.

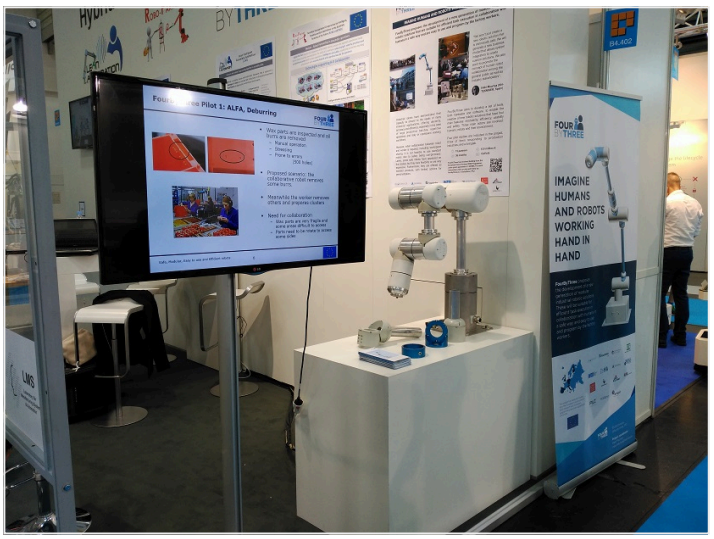
Lavoro eseguito dall'inizio del progetto fino alla fine del periodo coperto dalla relazione e principali risultati finora ottenuti

FourByThree has developed this 'kit' concept. The hardware kit is basically composed of four different actuators, the mechanical elements to create the arm, the electrical cabinet and different devices for interaction and safety (projection system, vision cameras).
The software tools are those needed to control and program the robot, safety and interaction components, the simulation wizard and the dynamic planning component. All of them are part of the FourByThree architecture.
To achieve a safe behaviour of the robot, FourByThree has implemented three basic components
• Force Monitoring, it is implemented at the actuator level, using the deflection of the springs and the motor intensity to estimate the force value.
• Speed and Separation Monitoring, implemented by means of two different components:
o the Projection system
o the proximity monitoring.
FourByThree provides different mechanisms to facilitate the interaction with the robot:
• The projection system can project information to the user and generate virtual buttons for interaction.
• A wearable user interface with and standard GUI in a handheld.
• Semantic interaction: Voice and gesture based interaction.
The control architecture is based on the ROS framework and allows introducing new features in the future.
The consortium has worked on the definition of this model and the strategy. To this aim, an ESS (Exploitation Strategic Seminar) and a BPD (Business Plan Development) have taken place. The final exploitation plan includes a webshop (http://cobot-shop.eu/) .
To promote the concept of human robot collaboration among the general public and industry stakeholders has been achieved by means of an intensive activity at three different levels:
• Participation in scientific and industry events, focused workshops (with industry and students).
• Face to face meetings with different industrial companies.
• General public, by the presence on those events, the website and the presence in different media.

Progressi oltre lo stato dell'arte e potenziale impatto previsto (incluso l'impatto socioeconomico e le implicazioni sociali più ampie del progetto fino ad ora)

Industrial-scale demonstrator of safe human-robot tight collaboration by sharing workspace and tasks, paving the way for potential improvements of the normative aspects.
•The four Pilot Studies have been completed and the experience gained can be used to provide feedback to the ISO group working on HRC. Two of the partners (PILZ and CNR-ITIA) take part in this group.

Increasing use of robot installation in traditional European robot-reluctant industries.
•Manufacturing sector is demanding robotic solutions that allowed coping with the demand of flexibility and increasing number of units to be produced. Moreover, small lot size production assembly are very common among SMEs.
•Collaborative robotic solutions, as this proposed by FourByThree, will contribute to answer to those demands and maintain jobs in Europe.
Increasing industrial-readiness and adaptability of human-robot collaborating manufacturing systems.
•Safety aspects are crucial for FourByThree. PILZ activity (risk assessment) and the support of a certification body guaranteed the required robustness.
•Fusion techniques have been used to cope with the variability of environmental conditions that may affect the interaction mechanisms
•The dynamic task planning framework, using ontologies in which human and robot capabilities are model, contribute to the work sharing between humans and robots.
Improved cost-efficiency through the use of symbiotic human-robot approaches.
•Time reduction and improvement of parts quality by the use of a collaborative approach have been measured in the Pilot Studies. In particular quality improvement has been demonstrated in the deburring scenario.
•In each Pilot Study a cost analysis has been done. The results show that the pure cost-benefit analysis are application dependent.
Strengthening the competitiveness and growth of companies
•A webshop has been created through wich it is possible to contact with results owners and download open-source, free access software components.
Social impact: Job creation
•Maintaining jobs, making some current manual tasks to be competitive thanks to the inclusion of cooperative robots
•Creating new jobs for the development and commercialization of results in the near future
Social impact: Improving quality of work for employees
•Repetitive and monotonous tasks (deburring)
•Non-ergonomic tasks in welding and riveting operations
Social impact: Reducing material waste and increasing yield
•Reducing faulty parts (due to incorrect deburring)



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