

# FourByThree

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

## Modular industrial robotic manipulators suitable for a safe human-robot cooperation

FourByThree proposes the development of 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. The acronym of the project refers to the two main foci of the project: the *four* main characteristics of FourByThree (Modularity, Safety, Usability, Efficiency) and the *three* main actors (Humans, Robots, Environment) in the manufacturing scenarios. FourByThree will design, build and test pioneering robotic solutions that are able to collaborate safely and efficiently with human operators in industrial manufacturing companies.

The project responds to the demand that robots used in industry need not only to provide accuracy and efficiency, but also ensure safety when collaboration between operator and robot is required, even when the workspace is shared. Thanks to the development of innovative hardware and software, the robotic solutions proposed by FourByThree will be modular, safe, usable and efficient.

One of the objectives of the European Call is on the development of intrinsically safe robot hardware on industrial scale leading to robots which are both safe and precise. In this line, FourByThree aims to build modular industrial robotic manipulators suitable for a harmless human-robot cooperation. In this project, the DFKI Robotics Innovation Center will provide the modular actuators and its low-level control which will serve as basis to build the robotic manipulators. These actuators are based on a recent rotary series elastic actuator design developed at DFKI which allows intrinsically safe robot behaviour.

For the modular actuators, four sizes were developed (i.e. actuator torques): 28 nm, 50 nm, 120 nm, and 300 nm. All of them are equipped with embedded

electronics (power electronics, communication, sensor preprocessing, FPGA-based control) and are composed of brushless DC motor, Harmonic Drive, elastic element and mechanical brake as well as the required sensors.



Set of actuators designed in the project

Duration: 12/2014 – 11/2017

### Partners:

Fundación TEKNIKER (Spain), DFKI GmbH (Germany), Fraunhofer IFF (Germany), CNR-ITIA // CNR-ISTC (Italy), King's College London (UK), ZEMA gGmbH (Germany), Deltatron Oy Ltd (Finland), Pilz S.L. (Spain), Antproject Tvip SL (Spain), KOMAT S.L. (Spain), EFS Gesellschaft für Hebe- und Handhabungstechnik (Germany), ALFA PRECISION CASTING, S. A. (Spain), Premium AEROTEC GmbH (Germany), WOLL MASCHINENBAU GmbH (Germany), Stodt Toekomsttechniek (The Netherlands), Ground Truth Robotics GmbH (Germany)

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