Corso di Dottorato in ICT
Doctoral Course in ICT

Research project for a PhD curriculum in ICT – Curriculum: Electronics and Telecommunications

Tutor: Prof. LUIGI BIAGIOTTI
(Possibile) Italian Co-tutor:
(Possibile) Foreign Co-tutor:

Proposed Title of the research: Development of a Mobile Collaborative Robotic Assistant

Keywords: Human-Robot Interaction, Human Intention Prediction, Multimodal Interaction, Learning by Demonstration.

Research objectives:
The main objective of this research is to develop an intelligent mobile collaborative robot capable of assisting humans in shared workspaces through natural and effective interaction. A key goal is to enable the robot to interpret and predict human intentions using multimodal inputs such as gestures, speech, and motion. This will allow the robot to act proactively rather than reactively, enhancing the fluidity of Human-Robot Interaction. The system will also aim to personalize its behavior based on the user's habits and context. Another crucial objective is to implement Learning by Demonstration techniques, enabling the robot to acquire new tasks by observing human actions, reducing the need for manual programming. The project targets real-time performance, adaptability, and safety in dynamic environments. The integration of robust perception, reasoning, and interaction modules is central to achieving these aims. Ultimately, the research seeks to build a robotic assistant that is not only functionally effective but also socially intuitive. This makes it suitable for applications in healthcare, industry, and home environments.

Proposed research activity
The proposed research activity involves the development and experimental validation of a mobile collaborative robotic assistant capable of interacting naturally with humans. The research will begin with the design of a multimodal perception system integrating speech, vision, and/or contact force feedback. A key component of the system will be a module for real-time prediction of human intentions based on sensor data. Learning by Demonstration techniques will be employed to teach the robot tasks through user demonstrations. Experiments will be conducted using two robotic platforms: a mobile manipulator composed of a Kairos base and a UR-10 robot arm for industrial-like scenarios, and the TIAGo robot for domestic environments. A modular software architecture will be developed to ensure adaptability across platforms. Human-robot collaboration tasks will be designed to evaluate system performance and interaction quality. Iterative testing will support continuous improvement based on user feedback. The final objective is to validate the robot's ability to assist humans safely, intuitively, and effectively.
Supporting research projects (and Department)
The research activity will be mainly accomplished at the Department of Engineering "Enzo Ferrari" and, at the moment of writing, is not supported by specific research projects.

Possible connections with research groups, companies, universities.

Dott. Sylvain Calinon, Senior Research Scientist at the Idiap Research Institute.
Prof. Claudio Melchiorri e Gianluca Palli, Università di Bologna (Laboratory of Automation and Robotics)
Prof. Alin Albu-Schäffer, Institute of Robotics and Mechatronics at the German Aerospace Center (DLR)