# ROBOCONNECT

## Communication Framework for Flexible Human-Robot Interaction in Industrial Manufacturing

**Pro²Future**

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## MOTIVATION & GOALS

In Industry 4.0, all actors in a production environment are interlinked. Humans, machines, and products communicate with each other. This **collaboration enables a flexible workflow** that is easily adaptable to changing demands, boosting productivity, efficiency, safety, and quality. To stay in the competition, businesses need to adapt their rigid routines, where humans adhere to an exact order of steps as robots are inflexibly programmed. In the future, strengths will be exploited for optimized working: **Robots act as assistants** for repetitive, physically demanding, or dangerous tasks, while **humans concentrate on more complicated parts** in production pipelines [1]. This project explores **real-time communication between humans and cobots**.

### Project FactBox

**Project Name** CobotInsight
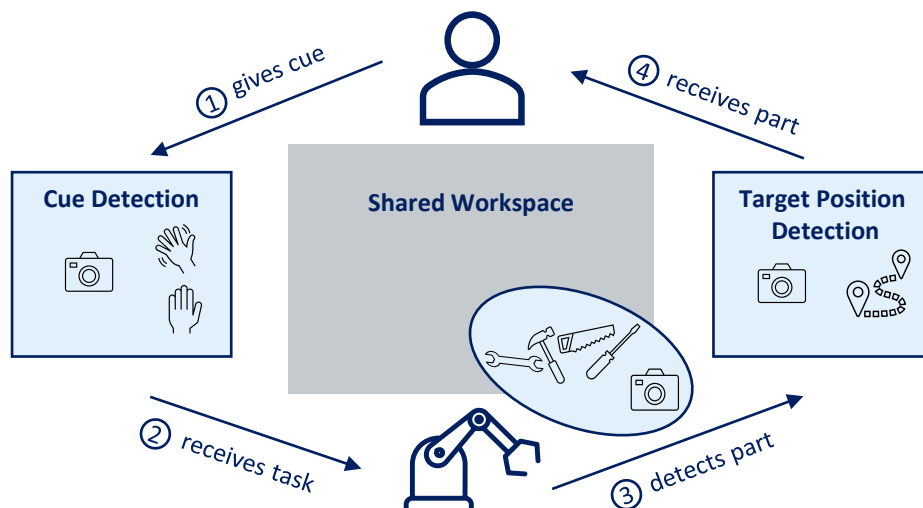**Project ID** StratP II 2.4
**Duration** 6 Months

**Area 2**
Cognitive Robotics and Shop Floors

**Project Lead**
DI Dr. Ouijdane Guiza

## APPROACH & SYSTEM ARCHITECTURE



## CONTRIBUTION

**Scientific contribution**
- Real-time signal processing
- Flexible communication pipeline

**Economic contribution**
- Increase in efficiency and profit due to process optimization
- Improved working safety and better user-friendliness of robots

Human-robot collaboration is realized by seamless **communication via cues**. Cobots execute part detection under changing working conditions without relying on preprogrammed locations.
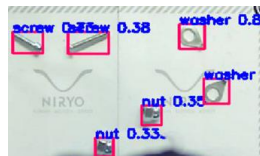
### Cue Detection

- Hands captured by environment camera
- Hand landmark detection with *MediaPipe*
- Cues detected using x & y coordinates of hand landmarks
  1. Initial cue detection to activate robot
  2. Specific cue detection for assistive tasks
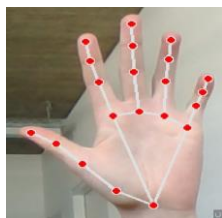


### Object Detection

- Workspace image extracted with camera mounted on robot
- Target object detected through color segmentation (*OpenCV*)
  1. Image segmentation with HSV thresholds for target colors
  2. Collection of object contours exceeding a minimum contour area size
- Barycenter of objects provides coordinates for pickup



### Target Position Detection

- Camera mounted on robot captures hand (*MediaPipe*)
- 2D distance between gripper and hand midpoint determines position shifts of robot (right, left back, forth)
- Robot shifted s.t. gripper and midpoint are close
- Part is dropped into hand
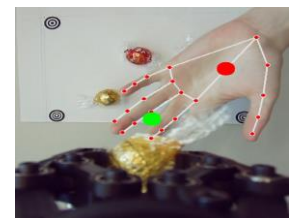


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[1] Othman, U.; Yang, E. Human-Robot Collaborations in Smart Manufacturing Environments: Review and Outlook. Sensors 2023, 23, 5663. https://doi.org/10.3390/s23125663