Human-Robot Collaborative Manipulation Challenge

The Rule of the game

- The competition environment will simulate an industrial scenario where a human and a robot cooperate to perform an assembly task.
- The operator (a team member) will be assigned the task of assembling a component using tools that will be provided by the robot.
- The robot must detect and localize the required tools on the table and hand them to the operator upon request. The sequence in which the tools are to be provided (communicated by the operator to the robot via a voice, gesture, graphical, or other interface) will be defined by the organizers on the day of the competition.
- The handover of tools must be performed as follows: The operator extends their hand toward the robot, and the robot places the tool onto the operator's hand.
- Once the tool has been used, the operator hands it back to the robot, which must reach for it, grasp it, and place it inside a colored area onto the table. The color of the area where each specific tool must be placed (communicated by the operator to the robot via a voice, gesture, graphical, or other interface) will be defined by the organizers on the competition day..

Evaluation and Penalties

Each team will have two attempts, each with a maximum duration (e.g., $T_{MAX} = 10$ minutes).
The final score will be calculated according to the following formula:

$$P = P_A + P_T - P_C - P_t - P_o + P_{B1} + P_{B2}$$

$P_A = 5\ N_A\ D$	$N_A = number\ of\ actions\ successfully\ completed$ $D = difficulty\ coefficients$ D=1 for simple tools to handle D=1.5 for medium-difficulty tools D=2 for difficult tools Example actions: 1. The robot grasps a tool from the table and correctly hands it to the operator. 2. The robot grasps the tool from the operator's hand and places it in the correct area.
$P_T = 15\left(\frac{T_{MAX} - T}{T_{MAX}}\right)$	$T_{MAX} = \max available\ time$ $T = completion\ time$
$P_C = 2\ N_C$	$N_C = number\ of\ collitions\ with\ obstacles\ and\ operator's\ body\ parts\ other\ than\ the\ forearm\ and\ hand$
$P_t = 2\ N_t$	$N_t =$ Failed or repeated tool handover attempts
$P_o = 2\ N_o$	$N_o = Number\ of\ objects\ incorrectly\ selected\ or\ dropped$

Bonus points may be awarded for:

- The most innovative cooperative approach ($P_{B1} = max\ 2\ points$)

In case of a tie, the result of the second attempt will be used as the tiebreaker criterion.