WARA Robotics Mobile Manipulation Challenge

The primary objective of the WARA Robotics challenge is to invigorate research activities in robotics among partner sites at WASP universities. Focused on the intricate domain of mobile manipulation, the challenge poses a compelling task that necessitates innovative solutions. By formulating a specific challenge, we aim to inspire research teams to devise ingenious and novel approaches to address the complexities associated with mobile manipulation. The challenge encompasses diverse sub-tasks, including mobility aspects such as navigation, mapping, and localization, alongside manipulation challenges like grasping and contact-rich insertion of pieces. Furthermore, it extends to perception aspects, involving object detection and pose estimation, as well as full-body control. Through this comprehensive approach, the WARA Robotics challenge aims to foster advancements in the fields of mobility, manipulation, and perception within the WASP research ecosystem.

Overall domain description

The envisioned scenario for the WARA Robotics challenge is grounded in the realm of lab automation, motivated by the challenges prevalent in scientific research, particularly within various biomedical domains. Despite advancements in research methodologies, many bio-medical tasks continue to rely heavily on manual labor. The challenge addresses a specific but essential sub-task persistently performed by lab assistants worldwide: washing glassware. While crucial for ensuring an adequate supply of clean equipment, this task does not demand specialized knowledge, yet consumes valuable time of highly-qualified research personnel.

Thus, the challenge we pose to the WASP community involves the development of a mobile manipulation system capable of partially automating this process. The system must autonomously navigate safely in a human-populated lab environment, localize carts loaded with glassware that needs washing, transport these carts to a designated dishwasher room, and manipulate the glassware for loading into an industrial dishwasher. Successful solutions to this challenge hold the potential to significantly alleviate the labor-intensive nature of lab work, allowing researchers to allocate their expertise to more complex scientific endeavors.

Challenge Tasks

The WARA Robotics challenge is composed of the following sub-tasks:

1. *Carting glassware that needs washing.*
   The first sub-task (see Figure below) concerns a mobile robot navigation and manipulation setup. In this task, the robot is to navigate an environment to a pre-set goal location where a cart full of glassware has been positioned. The robot is to then pull/push the cart and navigate again to a second marked location in a room where a dishwasher is set up. It is assumed that there will be no closed doors that the robot needs to manipulate along the way. For this task the robot has only onboard sensors available which can include for instance lidars and cameras. WARA Robotics will provide a 2D occupancy map of the environment as prior and allow teams to run a (teleoperated) mapping session prior to addressing the challenge, if desired. The task is considered successfully completed if the robot is able to push the cart from

the start to the goal location. It is also expected that the path the cart needs to take will include at least one left and at least one right turn.

2. *Manipulating glassware and dishwasher.*
   The second sub-task (see Figure below) assumes the robot is already at the dishwasher location and is presented with a table-top scenario. A box full of plastic beakers or similar plastic bottles is provided at one end of the table and a rack to mockup an industrial dishwasher is provided set-up at the other end. Both of these are placed roughly within pre-defined workspace zones. The task of the robot is then to select items from the box, pick them up, and insert them onto the pins sticking out from the dishwasher rack. Different levels of difficulty are envisioned in this task, ranging from very easy (small workspace feasible for a fixed-base robot, homogeneous non-transparent items tagged with QR codes) to very hard (large workspace that requires a mobile base, heterogeneous transparent plastic objects).

Figure: A cart (top left) is used to transport glassware that needs washing (top right) to a dishwashing area. The glassware is to be loaded onto a dishwashing rack (bottom left) and into an industrial dishwasher (bottom right).

Challenge Timeline

WARA Robotics aims at running the challenge final on-site in Västerås in December 2024. Here is the envisioned timeline:

April 2nd, 2024: This document outlining the challenge is published
May 1st, 2024: Deadline for expression of interest (see below)
May 15th, 2024: Sample challenge kits sent to qualified teams
June 3rd, 2024: Detailed rule book and scoring criteria published as well as challenge setup available for teams
December 16th, 2024: Challenge Day

Conditions

There are no restrictions in terms of what robotic system to use for the challenge.
If it is desired to use the ABB Mobile YuMi research platform, WARA Robotics will provide details on the robot as well as a simulation environment to get familiar with the interfaces. In such a case, integration days will be scheduled with the teams adopting the platform.
For the teams that instead prefer to use other robotic systems, they are required to bring such systems to the WARA robotics some time before the challenge day for on-site testing.
WARA Robotics will provide a toolkit to all the teams participating in the challenge. Depending on the targeted sub-task, the toolkit will include the cart and/or the box with the plasticware as well as the dishwasher rack with pins.

Expression of Interest

In order to facilitate organization and set up the number of kits we need to prepare, we ask that teams register for the challenge by May 1st. To register, send via e-mail to matteo.iovino@se.abb.com a 1 page pdf with the following information: main contact person of the team, expected team composition, expected hardware platform (mobile YuMi, fixed GoFa and fixed Franka arm are available at the WARA. Own system can be used, but transportation needs to be arranged by the teams).

Prize

We plan on offering prizes for the best team in the two sub-tasks individually, as well as the best overall solution. Overall solutions will need to handle transportation of the box from the cart to the desk autonomously as well.

Contact

Matteo Iovino: matteo.iovino@se.abb.com

WARA | ROBOTICS

AstraZeneca ABB