Project description

4487 Software Engineering for Cyberphysical Systems, 2024-2025

Description

We are owners of a logistics company for consumer items and are interested in deploying robots to pick items from the shelves in our warehouse automatically. We envision multiple (at least 3) robots that, after reading from a central queue of items to pick, will drive around, fetch the correct item from the correct aisle and shelf, and bring them to a central location. Obviously, the robots should not collide with any objects or with each other. One caveat: the aisles are not wide enough for multiple robots to pass next to each other; hence, every aisle should only have one robot at a time. In addition, we would like to use a web browser to manage the item queue as well as monitor the state of all robots.

Your task is to design the robots and their software (including the management software), equip them with whatever sensors/actuators you think are necessary to perform this task, and present a proof-of-concept solution that we can test in a simulated environment. We do not know much about robotics or software design, and we were thinking that you could provide us with the necessary knowledge and insight.

Simplifications

In order to limit the amount of work, you can make some simplifications:

- You can work in a simulator (e.g., webots: https://cyberbotics.com); no real robots need to be harmed 😊
- You may ignore the actual picking of the object by the robot. Moving to the correct location, staying there for a little while, and then returning to the central location suffices.
- You may assume that robots do not need to charge themselves.
- You may assume that there is a WiFi-connection in the storage hall. However, it is not always reliable and there might be dead spots where the robot has no (or a slower) network connection.

Practical

This assignment can be made in **teams of 2 or 3 students**. Register your team on Toledo.

You are free to use any programming language (or combination of programming languages).

There will be an intermediary presentation of your solution, where you can present your ideas and preliminary design to us (and the other groups) and get feedback. For this, we expect:

- A presentation of your envisioned solution and design

The deadline to hand this in is Friday March 21st, end of day.

For the final evaluation, we expect:

- A link to a **git repository** with all source code that you wrote for this project.

- A **report** on the design of your system. This report should primarily consist of **diagrams/figures**, and only a limited amount of explanatory text.
- A report with the **formal verification** (TLA+) of one interesting property of your system.
- A **presentation** about the design of your system, and the most important design choices you made.
- A **demonstration** of your system.

The deadline to hand this in is Friday May 2nd, end of day.

In principle, there will be no more lectures after the intermediary presentation in March. Questions about the project can always be asked via mail or via the discussion forum on Toledo. If necessary, one of the booked lecture slots can be used to make an appointment to discuss your questions in more detail.

Policy on the use of GenAI

For this project, you are allowed to use GenAI (ChatGPT, claude.ai, etc.) to get inspiration, learn about a particular topic, generate code, etc. However, remember that the output of such tools may be incorrect or unfit for the situation at hand. You are the only final responsible for your project, and we thus expect you to understand and be able to explain all design decisions and code of your project.

If you reuse material (code, text, figures) from elsewhere (e.g., a webpage), make sure to check the license, include a reference, and (if necessary) use the appropriate rules for citations.