Mobile Robot Challenge

Due May 1st 2023

The main goal of the Mobile Robot Challenge is to program the mobile robot such that it is capable to detect and estimate the distance to an unknown object, and such that the robot can drive very close to the object, or avoid it. This will be tested during three challenges:

1. Unknown object detection and distance estimation.
2. Unknown object avoidance
3. Unknow object search

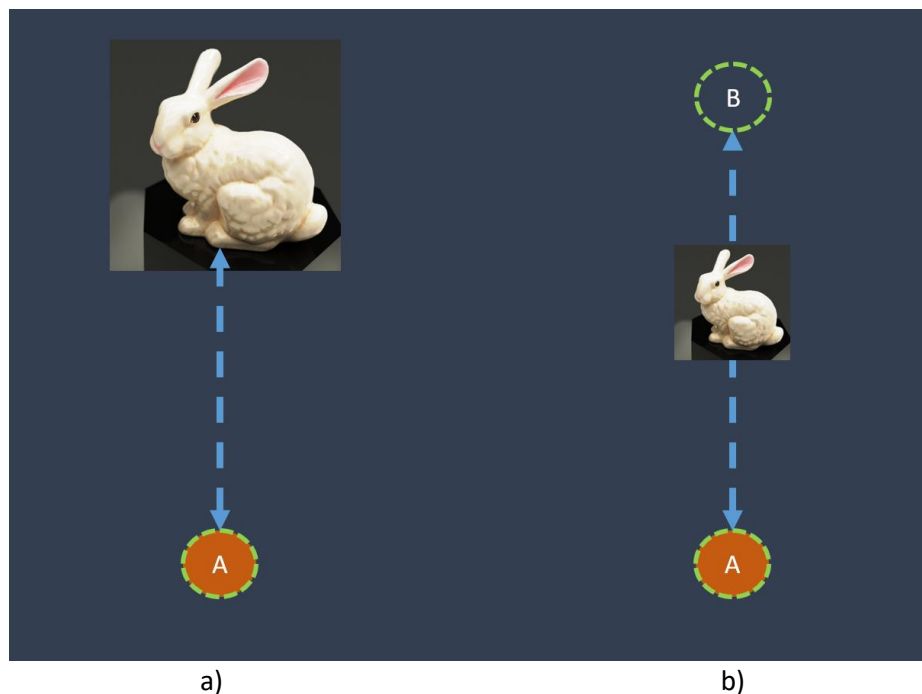## Challenge I Unknown object detection and distance estimation

Figure 1: a) Unknown object detection and distance estimation. b) Unknown object avoidance.

This challenge is depicted in Figure 1a.

1. An unknown object, typically of size ~ 7cm x 7cm x 7cm, and always clearly visible, is placed at a certain distance d ϵ [90 cm, 110 cm] from Position A.
2. Place your robot on Position A such that the camera is facing towards the unknown object.
3. Run your program. The robot should automatically output the distance from the camera to the object as an integer number of centimeters.
4. The object is placed somewhat further or closer to the robot.
5. Run your program. Your robot should drive towards the object and stop as close as possible to the object.

Challenge II Unknown object avoidance

This challenge is depicted in Figure 1b.

1. An unknown object, typically of size ~ 7cm x 7cm x 7cm, and always clearly visible, is placed at a certain distance d ∈ [100 cm, 150 cm] from Position A.
2. Place your robot on Position A such that the camera is facing towards the unknown object.
3. Run your program. The robot should automatically drive to Position B, located at a distance of around 200cm from Position A, thereby automatically avoiding the unknown object.
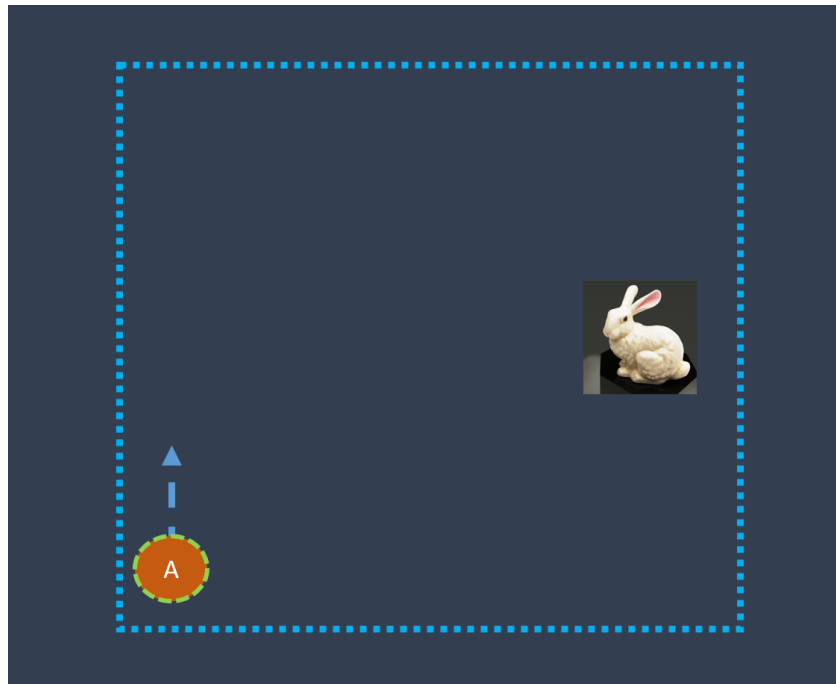
Challenge III Unknown object search

Figure 2: Unknown object search.

1. An unknown object, typically of size ~ 7cm x 7cm x 7cm, and always clearly visible, is placed on a random location within a region of 250cm x 250cm (see Figure 2). Position A is located at the left lower corner of that region.
2. Place your robot on Position A such that the camera is facing the direction of the arrow.
3. Run your program. The robot should automatically search for the unknown object and drive towards it and touch it with the front of the robot and subsequently stop.

Notes:

- **Turning:** Indeed, some mobile robots are able to turn on the spot, while other models require more space. Therefor you are allowed to use ample space to make any necessary turns.
- **Marker:** Marker A will be indicated by some tape.

Deliverables:

1. On May 1st and May 8th 2023 every team should show in a live demo that the robot is able to pass the three challenges.
2. Submit on Brightspace a zip-file containing your source-code and a pdf with a technical report (max 4 pages, font-size 12) containing a title, the name of the team, a list of all the team members a description and explanation of the methods used to solve the problems of the challenge and references to any libraries and papers used. Use a scientific writing style. Finally in an Appendix give the instructions of any dependencies of your code (i.e., extra libraries that need to be installed to get your code running) and how to execute your code to pass the three challenges.
3. The final grade will be based on the originality and robustness of your methods and solutions, the performance during the challenge and the quality of your code and report.