

Robótica Móvel e Inteligente

2018/19

Project 1

**Development of an agent for a robot that follows
black/white transition**

Objectives

- Understand the development mechanisms of microcontroller-based robots.
- Use the sensors of a real robot, understand their operation and limitations and develop techniques and methods to mitigate the impact of these limitations on the overall behaviour of the robot.

Project description

The project consists on the development of the control software of a black/white transition follower robot. In this situation, the path for the robot to follow is defined by the transition between black and white. Figure 1 depicts a possible configuration for the track that must be followed by the robot. In the case of a sudden transition from black/white to white/black, or vice-versa, the robot should continue to go straight.

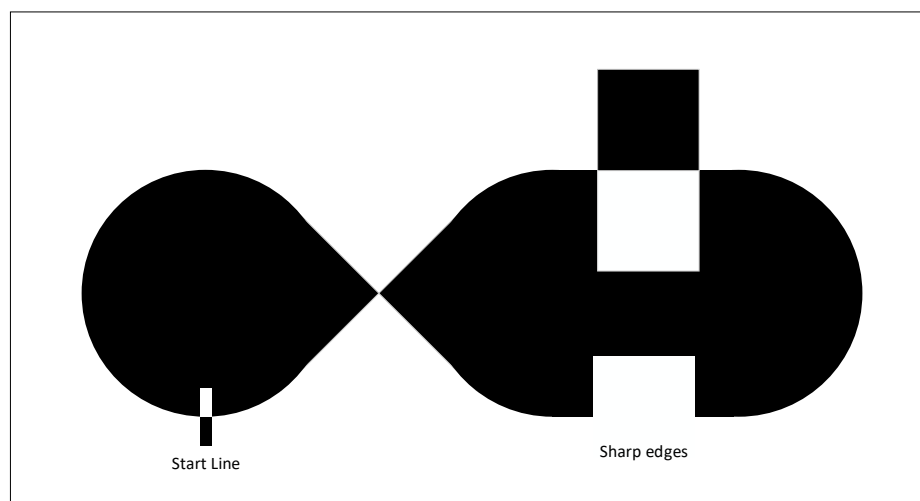


Figure 1: Example of Track defined by black/white transition

The project is organized in a sequence of challenges, of increasing difficulty, involving different navigation skills.

The list of challenges will be:

1. Simple navigation. The robot is positioned just after the start line and, once started, it must perform 2 complete laps, turn around, complete one more lap in the opposite direction and finally stop at the start line.
2. Navigation in challenge 1 with a sharp edge. A sharp edge will be added to the transition. The rules are the same as in scenario 1.
3. Navigation in challenge 2 with an obstacle. An obstacle will be placed over the transition, in a straight segment. The robot should perform as in the previous challenge but overtaking the obstacle. So, the obstacle should be detected and contoured in order to regain the transition, avoiding any collision.
4. Navigation in challenge 3. On one of the straight segments, two circles mark the beginning and end of a controlled speed segment of the track. Between these two lines the robot must move at a constant speed (to be defined) and turn on its LED. Furthermore, after completing the two first laps, the start line will be removed and the robot is supposed to stop as close as possible to the original position of the start line.

Deliverables

1. The control software developed during the project should be placed in a git repository in the `code.ua.pt` platform (a base repository will be created for all groups).
2. A report describing the approach used in the resolution of the problem should be written and made available in `code.ua.pt`. The report should describe the overall architecture, the implemented skills and how they were combined to solve the problem. It must also contain a results section, where results of the developed control software in overcoming the challenges should be presented, analysed and assessed. It should also contain references to documents (articles, books, reports, etc.) that have supported the development of the work. This report should be written using the LNCS template available at the following link: <http://www.springer.com/computer/lncs?SGWID=0-164-6-793341-0>.
3. Each group must prepare a presentation of its work which consists of three parts: an oral presentation, based on powerpoint or similar (10 minutes, maximum), a demonstration of the robot's performance (5 minutes, maximum) and finally a short discussion of the work. The presentation (in pdf format) should also be made available in `code.ua.pt`.

Evaluation

- Robotic agent (structure and performance): 45%
- Report: 25%
- Oral presentation and discussion: 30%

Important dates:

- Submission of deliverables: October 14, 2018
- Presentation: October 16, 2018

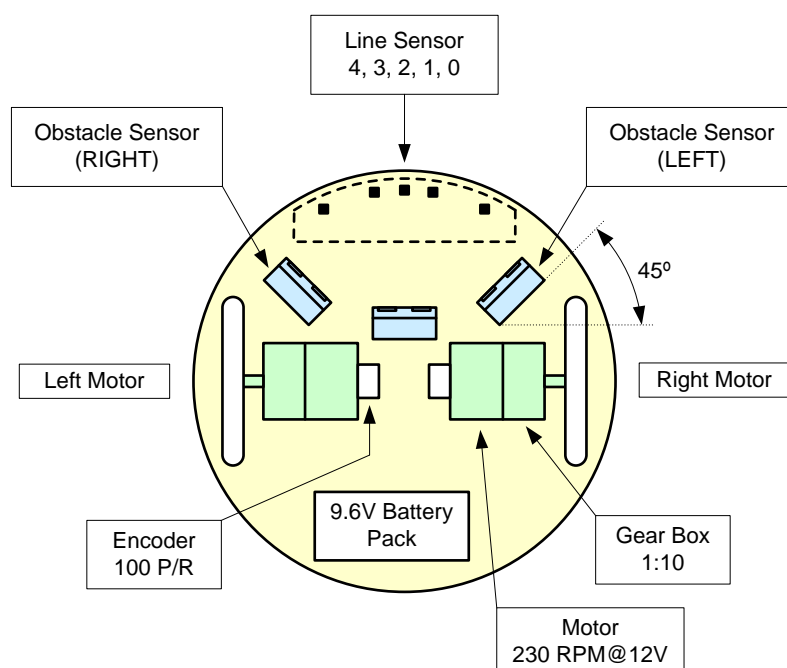


Figure 2 – Diagram of the Robot

Bibliography:

- "A Robust Layered Control System for a Mobile Robot", Rodney A. Brooks, *IEEE Transactions on Robotics and Automation*, 2(1), pages 14-23, April 1986.
- Part I – Robotic Paradigms of *An Introduction to AI Robotics*, Robin R. Murphy, Bradford Book, MIT Press, Cambridge, Massachusetts, London England, 2000. ISBN: 0-262-13383-0.
- *Behavior-Based Robotics*, Ronald C. Arkin, MIT Press, 1998, ISBN 0-262-01165-4.

Programming the robot

- 1) Use your favorite text editor to edit your program (use extension ".c", e.g. prog1.c)
- 2) Compile your program:
`pcompile prog1.c rmi-mr32.c`
- 3) Copy the binary file to the robot:
`ldpic32 prog1.hex1`
- 4) Check the program output in your PC:
`pterm`

¹ The first time you use these tools, you may have to perform the following configuration:

- 1) Check that the user belongs to "dialout" group, by executing the following command: `groups`
- 2) Add user to "dialout" group: `sudo adduser $USER dialout`
- 3) Logout and login again