

1 Robot Challenge: Mission 1

SG DS, 2. Semester

Please also note that clarifications or additions to the guidelines or missions may be made throughout the semester through questions & answers (FAQ). You will find updates on spaces.

The Future of Robotics – Autonomous Driving

Autonomous driving is a key component of future mobility, promising increased safety, more efficient traffic flow, and a more sustainable use of resources. By leveraging intelligent algorithms and sensor technology, autonomous vehicles can perceive their surroundings, make complex decisions, and navigate through traffic independently.

However, developing such systems requires exceptional precision and reliability. Every sensor, control system, and software component must be perfectly calibrated to ensure safe and seamless operation. Robotics plays a crucial role in this process, enabling testing, simulations, and the development of autonomous systems with the highest accuracy and efficiency.

This challenge is about understanding the principles of autonomous driving, developing your own algorithms, and successfully navigating a vehicle—taking a step toward the future of mobility.

As a first step into that direction, we tackle autonomous driving in a controlled setting following a line on the floor.

1.1 Main Tasks

Follow a black tape line and make rectangular turns forward from a start point to an end point. The start location and end location are marked with a white rectangular field. Left and right turns can be in arbitrary order. Decide yourself for an appropriate speed.

What sensors of Zumi are helpful for this task? Do not use the pre-implemented function *line_follower()*, program your own implementation.

Calculate the distance between the starting point and the final stopping position. Display the distance on the Zumi screen and save it to a csv (comma-separated-values) file. In the csv file, store also the timestamp of the starting time and the end time, the coordinates of the start and end position, the number of turns taken and intentional stops.

Store your code in a git repository and give access to the DS subject matter expert (Fachexpertin).

1.2 Surprise Tasks/Rules

A **surprise task** is an additional sub-task that teams can complete while solving the main task (e.g., an extra object that needs to be processed).

A **surprise rule** is a small modification to the existing mission that teams must adapt to (e.g., changing the color of objects).

Possible surprises:

- Changed color of tape.
- Make non-rectangular turns.

1.3 Extra Tasks

An extra task is an additional challenge similar to a surprise task, but teams are informed about it before the competition so they can prepare.

- Blink the corresponding lights when you make a left or right turn.
- Conduct a U-turn once the end location is reached. Store end location and make a U-turn within the buffer field (yellow)
- Stop when a fully crossing line is recognized.
- Park your car into a parking lot and move out backwards. The parking lot is indicated with a round marker next to the line.

1.4 Grading

1.4.1 Main Tasks

Criteria		Max Points
The Zumi robot is fully inside the end location. The robot is considered fully inside a designated area only if it touches exclusively that area and does not overlap or extend into any other regions. Assessment: If any part of the robot is outside the defined area, even minimally, it is not considered "fully inside".		
The Zumi robot is partially inside the end location.		
The Zumi robot left the black line to follow completely for certain periods of time.		
The Zumi robot managed n number of turns.		Number of correct turns
All requested values are stored in the CSV file.		Per value x points
Timing		

1.4.2 Surprise Tasks

Criteria		Max Points
Zumi managed to follow the lines of one different color		
Zumi managed to take non-rectangular turns		

1.4.3 Extra Tasks

Criteria		Max Points
The Zumi robot was blinking every time when taking left turns		
The Zumi robot was blinking every time when taking right turns		
The Zumi robot conducted a U-turn in the end location		
The end position of the U-turn was within the buffer zone (yellow tape) of the end location		
The Zumi robot could park into the designated parking lot		
The Zumi robot could reverse out from the parking lot		
The Zumi robot stopped when a fully crossing line was recognized		Number of times recognized.