

Robotics&Automation

ENGT4314

Lab Assignment - Grand Challenge

Lab Assignment 5 *Group Assignment (4 students, 4 weeks)* Due: week 12

For this project, you will implement a navigation task on the Pioneer AT robots using multiple sensors, similar to the DARPA Grand Challenge competition. Sensors available are:

- GPS sensor with USB-serial interface
- Digital compass with USB-serial interface
- Digital color camera (Logitech Sphere, can be rotated in two axes)

Full documentation on the Pioneer AT robots and the sensor systems will be made available to you.

As this is a group project, you need to discuss among your group member who will take over which part of the project. You will need to set internal deadlines and introduce internal reporting. Marking of this lab will be based on the group's lab solution as well as on lab reports of each individual group member.

Task: Implement a robot navigation system that solves the following requirements:

- The robot reads a given set of **GPS way points** at initialization time.
 - The robot will follow the GPS way points in the given order.
up to a certain proximity (e.g. 10m), then use image processing for fine path planning
 - After clearing an obstacle, the robot continues driving to the next way point.
 - Each way point is marked with a box of distinctive color (yellow or red).
 - Use **image processing** to identify each box by color.
For every detected object, record the x,y-position of the object center together with the robot's position and orientation in an (fixed size) array data structure.
 - Considering the previous and next way point, pass the box on the **outside** track.
Always **avoid collision** with a box.
 - During each run, the robot will maintain a data structure that plots its driving path (at least one entry per second).
 - Upon completion of the task, the robot will write this data structure to a text file, which can be then converted to a graphics plot (e.g. using Excel). This **plot** has to be included in the **lab report**.
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Bonus points:

- Avoid stationary and moving obstacles, such as buildings, walls, trees, and people with the help of image processing (2 points).
- Use differential GPS for improving navigation accuracy. An additional GPS module is available, but you also need an additional laptop with WIFI to implement this (3 points).

Lab report: A lab report has to be submitted by each individual student, including the following information:

- Split of assignment tasks between group members
- Time spent on own assignment task
- Documentation, describing design choices and solution path
- Well-documented source code
- Full set of measurements and graphs
- CD-ROM (or other media) with drive video and recorded path data (only one per group)