ELEC330
Assignment Three
Jetbot Autonomous Navigation & Object Detection

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Abstract

This third and final assignment has a weight of 60% of the total grade. The mark is equally split between the team robot demonstration and the individual report. The assignment is issued on the first week of the second semester. The team demonstration/bench test deadline is during the laboratory session of last week of the semester and the individual report is due on Friday of last week of the second semester. This assignment is very important as it carries the most weight of the overall grade. The assignment relies on the learning you have acquired during assignments 1 and 2. It is also considered as a resit for the previous assignments with a 40% cap.

1 Assignment requirements and marking criteria.

Table 1 summarises the assignment requirements.

Module	ELEC330
Coursework title	Assignment 3
Component weight	60%
Semester	2
HE level	6
Lab location	lab sessions and private study
Work	Teamwork in an allocated group
Timetabled time	30 hours (3 hours per week)
Suggested private study	16 hours including report writing
Assessment method	1) Bench test as a team to demonstrate the performance of the Jetbot. 2) Individual, formal word–processed reports in addition to video and code.
Submission format	On–line via CANVAS
Submission deadline	Individual Report: 23:59 on Friday 28^{th} April 2023 Team Demonstration: during the laboratory session Tuesday 25^{th} April 2023
Late submission	Standard university penalty applies.
Resit opportunity	August resit period (if total module failed)
Marking policy	Marked and moderated independently
Anonymous marking	No
Feedback	verbal and written.
Learning Outcomes	LO5: Describe and implement sensing in a robotic system. LO6: Define and implement a system for navigation of a robotic system. LO7: Explain how machine vision, machine learning and human machine interfaces augment capability of robotic systems.

Table 1: Assignment Requirements

Table 2 summarises the assignment individual report requirements.

Section	Marks available	Indicative Characteristics	
		Adequate/pass (40%)	Very good/Excellent
Clarity of presentation (including succinctness) of main report	20%	2–page executive summary. Comprehensible language with adequate grammar and punctuation. Documented code in appendices	Appropriate use of technical language. All sections clearly signposted. Correct cross referencing to appendices. Annotated code files including readme files.
Methodology and testing scenarios	40%	Adequate explanation of your role within the team and what you have contributed. Explanation of all contributions in preparation, coding and testing scenarios of the robot navigating autonomously to target.	In depth explanation of contribution, code and testing scenarios to detect the required object. Video showing the detail of the testing of various navigating scenarios.
Quality of discussion, reflection and conclusion	40%	Critical assessment of the efficacy of your role in achieving mapping, autonomous navigating the arena and identifying target. Discussion on what worked and what did not and its impact on others roles.	Discussion how your role contributed to the robot successfully navigated its world and how you contributed to fully assess/test the robot mapping and navigation. How your role linked and affected others roles

Table 2: Marking Criteria for the Individual Report

Table 3 summarises the assignment group bench inspection requirements.

Section	Marks available	Indicative Characteristics	
		Adequate/pass (40%)	Very good/Excellent
Testing of all sensors	20%	Successful interfacing with at least two of the four sensors.	Successfully interfacing with all sensors and integration with ROS.
Creating a map of the arena	20%	Creating one map using manual/keyboard navigation	Creating more than one map and comparing maps together to ensure a complete and accurate map. Assessing the accuracy of the map
Safe navigation and recognising target	40%	Autonomous navigation of the robot based on at least two sensors.	Safe autonomous navigation, identification of the target object and parking the robot next to target object.
Answering questions	20%	adequate answers showing some understanding.	Comprehensive answers showing indepth understanding.

Table 3: Marking Criteria for group bench inspection.

2 Assignment Outline

In this assignment you will

- Work **collaboratively** within your team.
- Make use of all the concepts you have implemented in assignments one and two.
- Use a real mobile robot called Jetbot illustrated in figure 1.
- Use sensors attached to the Jetbot to map and autonomously navigate within a set arena.
- Get the robot to identify one object placed in the arena and park next to it.
- Demonstrate interfacing the sensors and using ROS to broadcast sensors data.
- Demonstrate mapping of the arena.
- Demonstrate safe autonomous navigation based on the acquired map.
- Demonstrate object recognition capability of the robot.
- Individually report on your own role and explain in detail your contribution, how it linked to the overall performance of the robot.

Figure 1: The Jetbot

There are no requirements on:

1. the robots initial/starting position.
2. the position of the target object.

During working on this assignment, you shall endeavour to

- Resolve any conflicts that may arise within the team.
- Complete the tasks on time.
- Demonstrate all the tasks by and submit before or on the deadline.

2.1 Submission Deadline

The submission deadline for individual report of the assignment is **Friday** 28^{th} **April 2023** at *23:59*. You will submit your report and code on–line using the dedicated link in the module page on VLE platform (CANVAS).

The deadline to demonstrate the performance of the robot as a team is during the laboratory session on **Tuesday** 25^{th} **April 2023**.

3 What to submit for the individual report

You will submit an executive summary, a detailed report, code and a video as follows. Use appropriate names for all files and **zip them in one file** to submit.

3.1 Executive Summary

You will submit a 2–page executive summary with a maximum of two figures (excluding any appendices) in 10 point font with no less 2cm margins. Note that this summary is very important and will be the only part that is completely read by the marker. It should include all what is needed to get the reader acquainted of what you have achieved and how your contribution links to the overall team and performance of the robot. The reader should not have to refer to any other material. The executive summary should include

- Summary of the your role.
- Explain the methods you used to complete the tasks you were responsible for.
- Discussion and reflection on (1) how your role contributed to the overall performance of the robot, (2) How your role linked to other members in your team, (3) how did you resolve any conflicts, and (4) your learning experience.
- Conclusion.

3.2 Appendices

You should use appendices where you include the detail of all the steps you have gone through to acheive the tasks that you were responsible for. The appendices should include a detailed section. A reflection section on what worked, what did not work, what are the lessons learnt and skills acquired.

3.3 code

This will include any code you have written or used to complete the assignment. This will also include all the coding files. All code and files should be appropriately documented and annotated.

3.4 video

Submit a video showing completion of your role and tasks associated with it.

4 What to demonstrate as a team in the bench inspection

During the bench inspection your team need to demonstrate the following

- Demonstrate interfacing the sensors and using ROS to broadcast sensors data.
- Demonstrate mapping of the arena.
- Demonstrate safe autonomous navigation based on the acquired map.
- Demonstrate object recognition capability of the robot.
- Get the robot to identify one object placed in the arena and park next to it.