CENG2400 Embedded System Design
Final Project Requirement

Title: Autonomous robot control

Objectives/Aims

- To practice the programming of a microcontroller using a high-level language (e.g. “C”)

Requirement

- **This is an individual project. Each student should complete the following tests.**
- Test 1, referring to Figure 1, the robot should be able to run along a straight line from any location within the “START zone (in blue)” to the “END zone (in red)”. There is no obstacle in the path.
- Test 2, referring to Figure 1, the robot should be able to run from the location of the “START zone (in blue)” to the “END zone (in red)” and avoiding one obstacle (in black).
- For each test, the maximum number of attempts is 5.
- A demo of Test 2 can be found at https://youtu.be/KpoBiWXfnnU
- You have one week to complete the program, the deadline of evaluation is 5:30pm, 28 Nov 2018.
- Marking criteria:
  - Speed: The faster to reach the target the better.
  - Motion control elegance: Smooth turns will gain higher marks.
  - Accuracy: can run in straight lines and not bumping into walls.
  - Strategy: Use of the sensor will score higher marks; hardcode the path will score less.
  - Lab report. Format see appendix (Maximum pages: 15). Deadline for submitting the report is 2 Dec 2018 23:59.

Testing Scheme

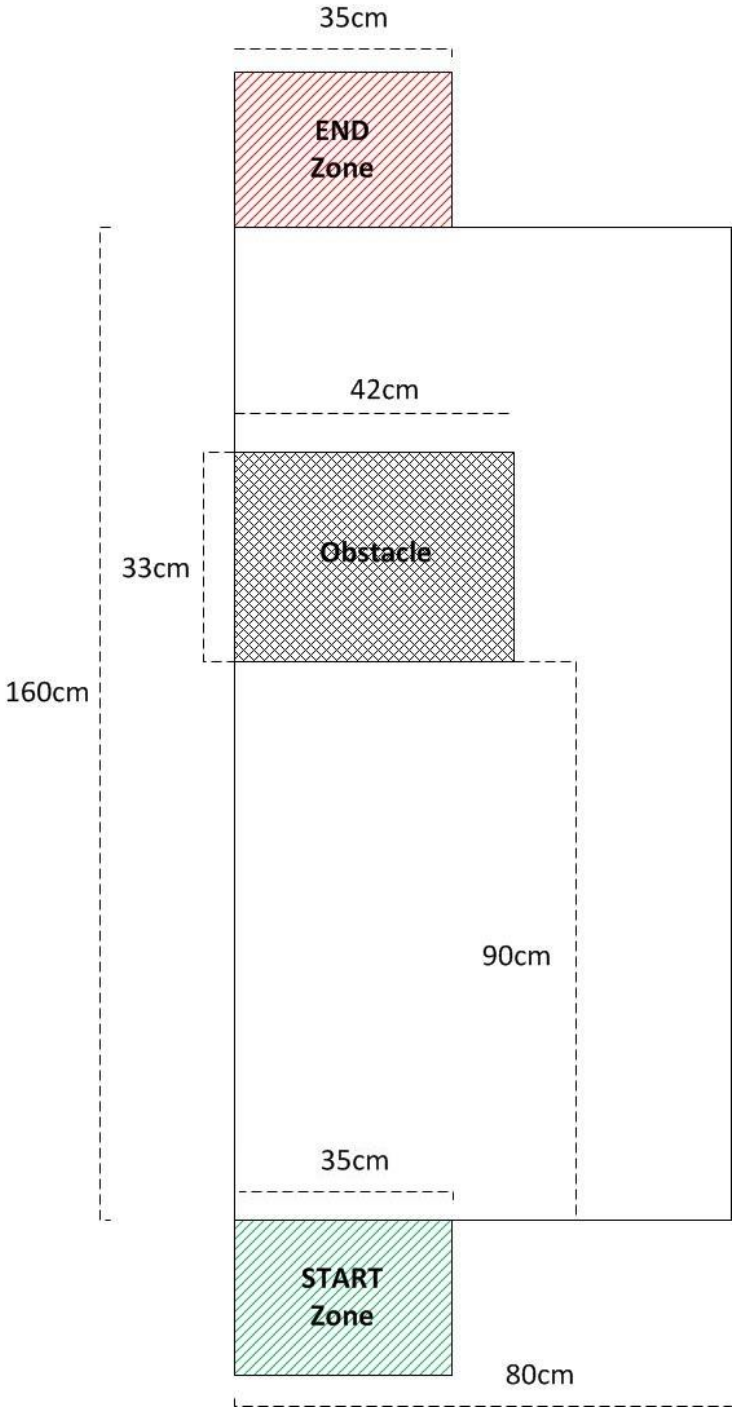

Figure 1. The testing path for Test 1 and 2

Reference:

The document **CENG_2400_project.pdf**.

The demo code is inside the zip file **CENG2400_2018**.zip, which can be downloaded from Piazza project.

Appendix (a report guide to help you to prepare for this exercise and other course projects)

Report Requirements and guidelines: (version 12d)

Your report should be typed on A4 papers (5-12 **pages including appendices, figures, etc., Abstract (15%):**

- About 100 words, this summarizes the whole report – from Introduction to Conclusion. Since in some research document databases the reader can only access the abstract but not the rest of the report, so the purpose is to give the reader a brief summary of what you have done in this project.
- You may rephrase some contents used in the introduction and conclusion here. Some writers prefer to write the abstract after the report is completed from introduction to conclusion to make sure it contains all essential elements of the report.
- Abstract is an independent segment of your report, it has no chapter/section index – do not call it chapter 1 or section 1. It has no cross reference as well.

1. Introduction (15%):

This is the real beginning of your report. Since the abstract only presents a brief summary to readers, therefore you may repeat what you have written in the abstract here.

An introduction can be a chapter containing the answers of the following questions:

- What is the problem you want to solve? (Problem definition)
- Why the problem is important? (Motivation)
- What are the previous solutions by yourselves or others? (Review, include cross references)
- What have you achieved in this project? And how good the result is compared with other approaches? (Contribution)
- What is the structure of this report? (Content of the report; Chapter 3 is the description of the theory and design etc.)

2. Theory and design (20%)

- Overview: describe the architecture and overview of your project. Use flowcharts and block diagrams for better presentation.

- Always remember to tell readers what is the input of your system (e.g. image features, IR sensor inputs etc.), and what is the output (e.g. model, pose, motor speed, output voltage etc).

- Module descriptions: discuss each module of the system clearly and the interactions among them. The guidelines are as follows.

    i. Justify the selection and applications of the modules (the mechanical parts, hardware parts and software).

ii. Give name/model numbers of the components. Insert diagrams if possible,

iii. Declare assumptions: For example, you may assume there is no Radio Frequency (RF) noise exist when using an RF remote controller, etc.

iv. Circuits: Block diagrams are preferable, detailed circuits should be placed in the appendix. Explain the operations of the circuit and explain why such circuits are necessary.

v. Software: Describe the algorithms by using flow diagrams or pseudo code, explain why these algorithms are necessary. Insert screenshots of your GUI designs if possible. Source code maybe placed in the appendix if necessary.

3. Implementation and experimental result (20%):

- Implementation: describe how the system was integrated to become the final product. Use past tense to write this part.
- Experimental result: Any system built should be tested to evaluate its performances. State the procedures of the experiments (past tense) and show the results.
  i. Use tables or graphs: For example, for a temperature control system, you can plot a graph showing the temperature change against time.
  ii. Avoid using qualitative description to describe results (e.g. large, small, heavy etc), use quantitative measures instead (e.g. temperature in degree Celsius, power in Watts etc).
- Answer the following questions:
  i. Does the result match your expectation?
  ii. What have you learned from the result obtained?

4. **Discussions (15%)**

i. Expectations: Can you obtain the expected results?
ii. Discussion of the evaluation results in the section of "implementation and experimental results".
iii. Difficulties, limitations.
iv. Others: e.g. trade-off of the system (like memory-time trade-off), cost of production (is the design suitable for mass production)……
v. Further improvement.

5. Conclusion (15%)

State clearly what you have achieved in this project.

- What is the problem you want to solve? (problem definition)
- What have you achieved in this project? And how good the result is compared with other approaches? (contribution)

6. References

- **(No section index; optional, may use web links as references)**
- use the order of appearance in your report to index the references.

7. Appendix (optional)

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