Project 1 - MEC830 - Fall 2022

(Individual Work)

1. Purpose

The purpose of this project is to gain in-depth hands-on experience with mechatronics topics.

2. Scope

You will work with sensors, actuators, and controlling a system with Arduino.

3. Documents

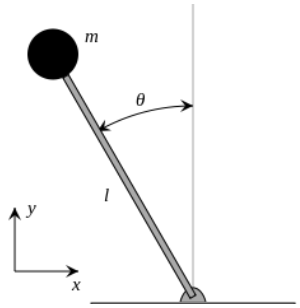
The following documents will help you through the Lab:

- Lecture notes
- ELEGOO programming examples

4. Procedure

Familiarize yourself with the ELEGOO Starter Kit.

- Try loading the examples from class and the kit.
- Use the serial monitor to help debug your program.



Inverted Pendulum

You will design a self-balancing inverted pendulum. You may use any of the components in your system. The length of the pendulum (l) is 20-50 cm. Mass (m) is 30-100 grams. You should demonstrate that the design is able to stabilize the pendulum when a small disturbance is applied to the mass, e.g. by poking it in the x direction.

- **Design-**Electronic components: only the parts provided with the ELEGOO kit should be used.
- **Design-**Mechanical Components: use commonly available objects such as bottle caps, cart boards, etc. It is expected that the mechanical components should not cost you anything.
- **Timeline-**The project should be delivered according to the deadline of the course schedule.
- **Budget-**If needed, you can spend up to $30 to purchase the parts (mechnical/electrical) you need for your design. 3D-printed parts are allowed with no limits.

Your work will be evaluated based on the following metrics:

1) The novelty of the design.
2) Design details: electrical, mechanical, control, programming design/charts/schematics
3) Software version control
4) Stability of your system (metrics such as fast response, and robustness to disturbances should be taken into account)
5) Quality of the report.
6) Design steps (including all topics discussed in the lectures)

5. Report and Marking Scheme

Your lab report (2.5-inch page margin, 12-point font, double line spacing) should include:

1. Signed report cover page *(if it is a group work, put your lab group number on the front)*
2. Abstract [1%]
3. Table of Content [1%]
4. Introduction [1%]
5. Simplified Design Process
    - 5.1. Problem Definition [12%]
    - 5.2. Solution Formulation [8%]
    - 5.3. Modelling and Prototyping [16%]
        - 5.3.1. Mathematical Modeling
        - 5.3.2. Simulated Modeling
    - 5.4. Implementation [20%]
        - 5.4.1. List of Materials
        - 5.4.2. Schematic and Technical Design Details of Electronics
        - 5.4.3. CAD models and Technical Design Details of Mechanics
        - 5.4.4. Controller Design and Block Diagram of Control System
        - 5.4.5. Flowchart and Description of the Software Program
6. Conclusions & Recommendations [2%]
7. References (IEEE Style) [1%]
8. Appendix: Program Listing [1%]
9. A video of the tasks (not more than 3 minutes) [4%]

Attendance [4%]
Live demo: demonstrating a working demo in-person [20%]
Design Novelty [3%]
Performance metrics [4%]
Quality of report [2%]

6. Important Notes

- The project's due date is on D2L.
- Submit the report to D2L→ Assessment → Assignment → Project1 (no hardcopy is needed)
- Late submissions will be penalized at 10% per day, where weekends count as two days for online submission. A fraction of a day is considered a full day.
- This is individual work. Every student needs to submit their own report, and build/demo their own system.
- Lab attendance is mandatory. If you submit a report without attending the lab, you will get zero marks.

- Report file name convention:
    - Report_Section#_Student-ID_ Last-Name_First-Name_Project1.pdf, e.g.
    - Report_09_00099887766_Smith_John_Project1.pdf

- Your code also should be submitted in a zip file, if more than one file needs to be submitted. Otherwise submit the code unzipped. Code file name convention:
    - Code_Section#_Student-ID_Last-Name_First-Name_Project1.pdf, e.g.
    - Code_09_00099887766_Smith_John_Project1.[c, zip]