LAB 3-MEC830
Actuators
(Individual Lab)

1. Purpose
The purpose of this lab is to get-hands-on experience with actuators.

2. Scope
The scope of this lab session is to learn how to use the ELEGOO actuators. You will work with 1) servomotor, 2) stepper motor, and 3) joystick.

3. Documents
The following documents will help you through the Lab:

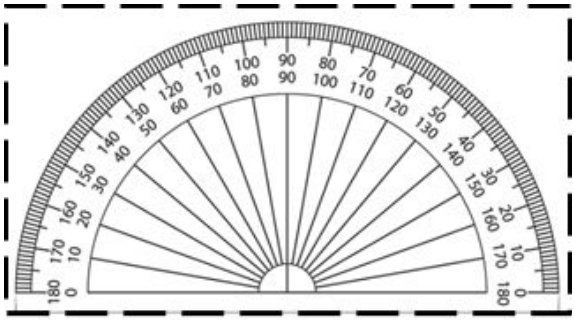
- Lecture notes
- ELEGOO programing examples

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.
- Identify all actuators in your kit.

This lab has three tasks. Once Tasks 1, 2 and 3 are working properly, demonstrate to your TAa and ask them to sign off. These tasks should be finished during the lab hour.
Watch these videos to see how this should work.
Task1: https://youtu.be/fcCxhh6gOzo
Task2: https://youtu.be/QUAOAgdcoSE
Task3: https://youtu.be/xXLsxdk5AKM

Write separate programs for task 1, 2, and 3. Extra information about the components are also in the datasheets. You may need a protractor.



Task 1: Servomotor

(a) connect the servo motor to the Arduino UNO.

(b) make a Tinkercad model and implement the code as described below.

(b) write a program that when you press button 1, the servo turns 45 degree CW and when you press button 2, the servo turns 45 degree CCW. You may use a protractor to measure the angles.

- To familiarize yourself with the servo motor, see ELEGOO lesson 2.8.

Quantity	Component
1	Arduino Uno R3
2	Pushbutton
1	Micro Servo

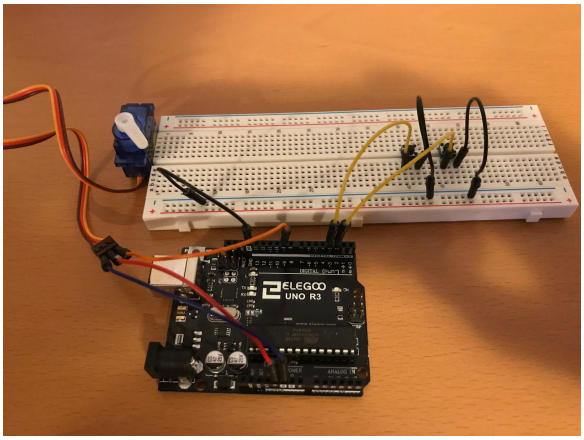


Figure 1: Bill of Material and a reference image for Task 1

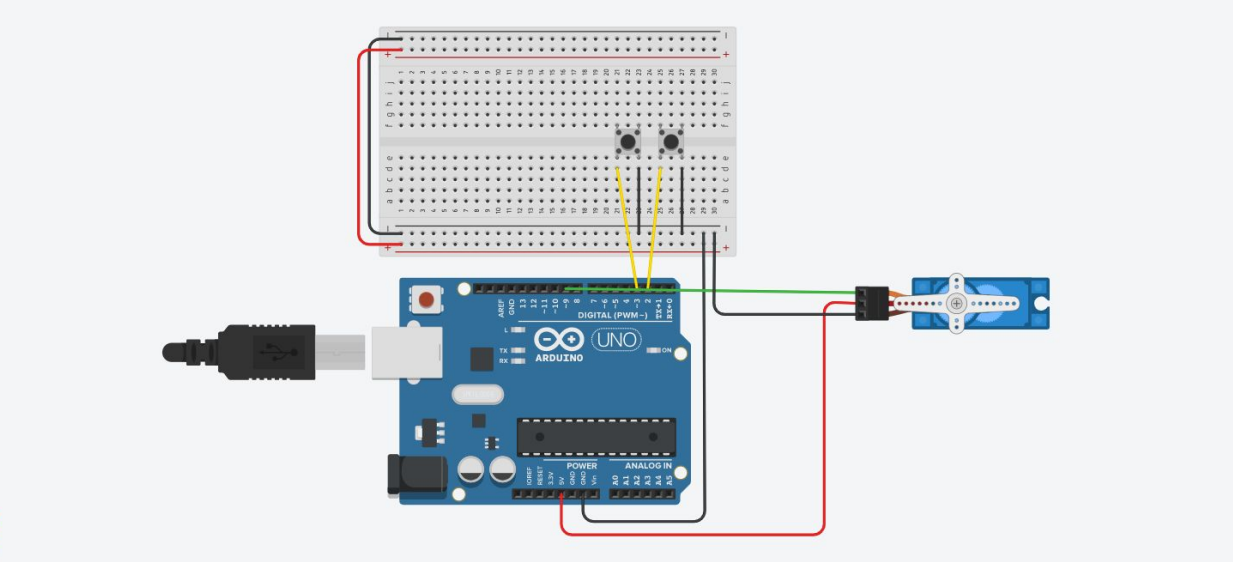


Figure 2: Schematic for Task 1

Task 2: Stepper motor

(a) Repeat task 1, but this time use the stepper motor.

- To familiarize yourself with the stepper motor, see ELEGOO lesson 3.7.
- To power the stepper motor, you must use the power supply module with the 9V battery connected. Lesson 3.7 will mention a 9V, 1A adapter (that connects to the power outlet) under the components section; however, this is not included in the kit, so use the 9V battery with the snap-on connector instead. Make sure the power supply is switched on by pressing the white switch (a green LED on it should light up) as shown in Figure 4.
- The internal shaft of the stepper motor has 32 steps per revolution, and the output shaft has a gear reduction of 64, so the output shaft has 32 x 64 = 2048 steps per revolution. This means the output shaft's speed is reduced 64 times from the rpm set to the internal shaft.
- Be careful with the connections as 9V is what is needed to drive the stepper motor, but the arduino board and the other components work on a lower voltage level, so if any component gets hot, turn off the power supply module and recheck the wiring.

Quantity	**Component**
1	Stepper Motor
1	ULN2003 Stepper Motor Driver Module
1	9V Battery with Snap-on Connector
1	Power Supply Module
2	Pushbutton

Figure 3: Bill of material for Task 2

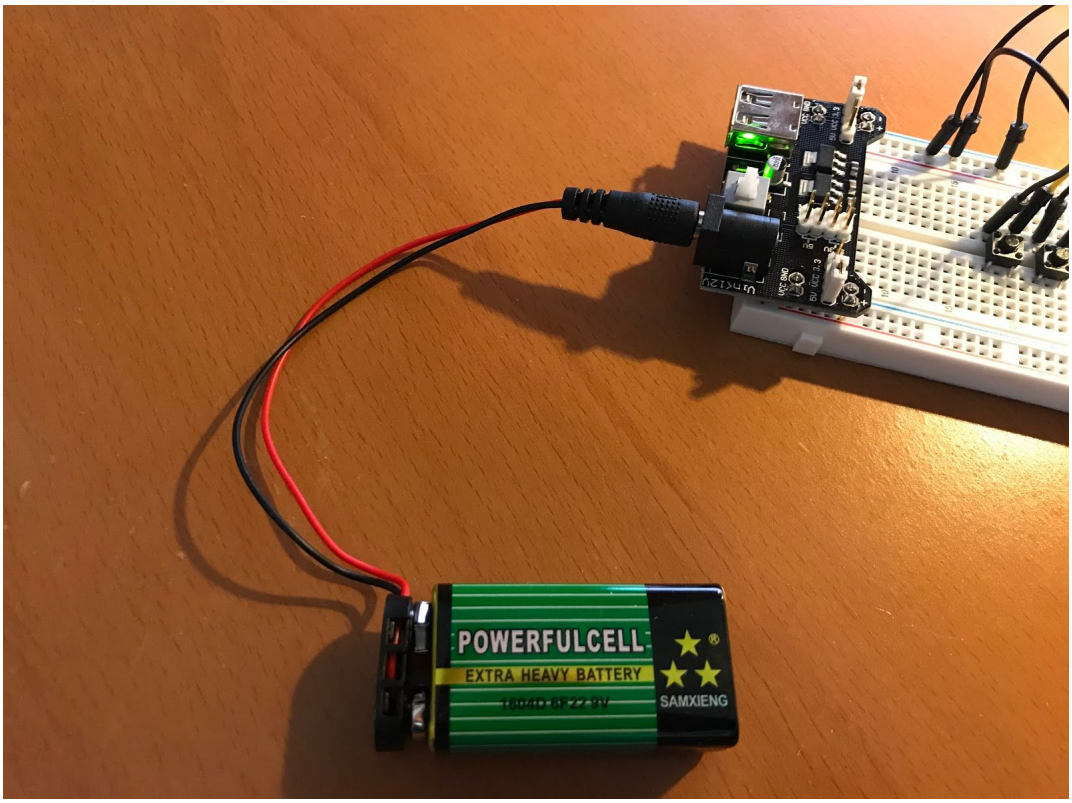


Figure 4: Implementation of 9V battery with snap-on connector

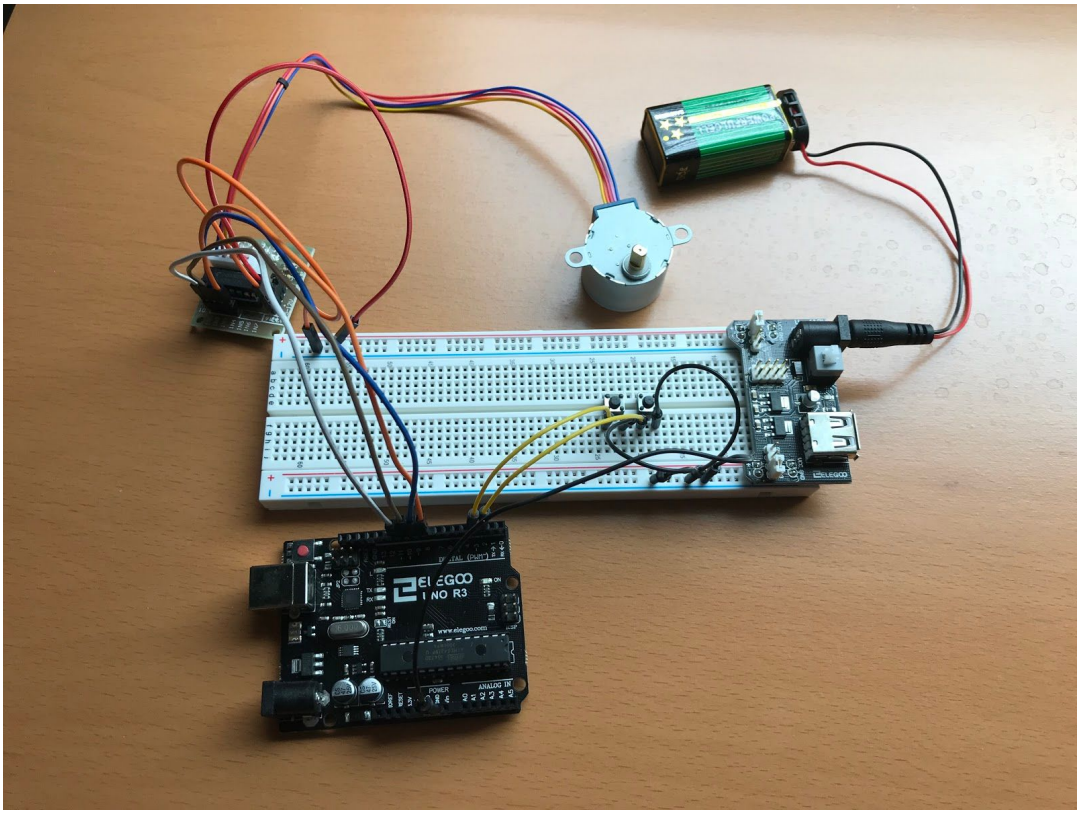


Figure 5: Reference image for Task 2

Task 3: Servo, Stepper, and Joystick

(a) Connect stepper, servo, and the joystick to the Starter Kit. write a program that:

(b) When the joystick moves to right/left, the servo moves CW and CCW. Adjust the max range of the joystick with the max range of the servo.

(c) When the joystick moves forward/backward, the stepper turns CW and CCW. Adjust the speed of the stepper with the position of the joystick, i.e. as the joystick's motion increases, the speed of the stepper should increase.

- To familiarize with the analog joystick, see ELEGOO lesson 2.11.
- In this task, you'll be using the stepper motor which receives its 5V from the power supply module, and the joystick and stepper which should receive it from the Arduino, so you may use the mini-breadboard to make the VCC and ground connections with the arduino.

Quantity	Component
1	Stepper Motor
1	Micro Servo
1	ULN2003 Stepper Motor Driver Module
1	9V Battery with Snap-on Connector
1	Power Supply Module
1	Joystick Module

Figure 6: Bill of Material for Task 3

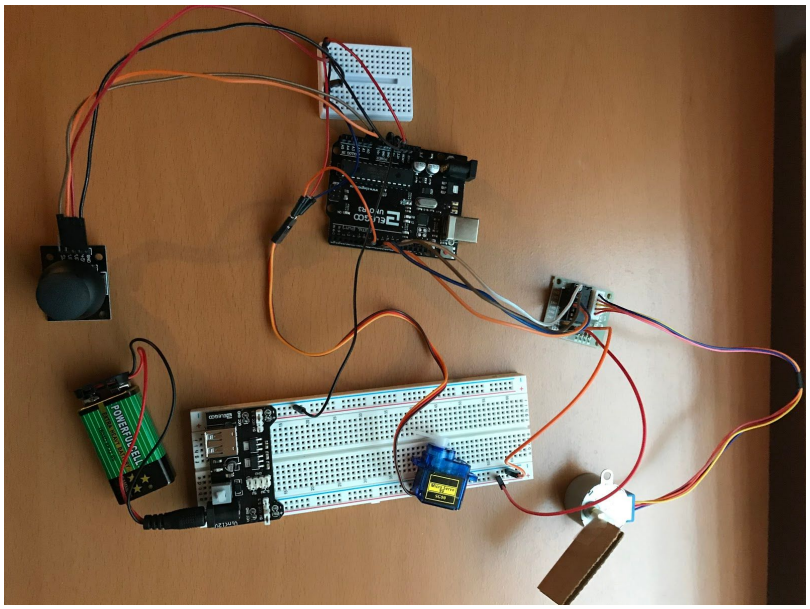


Figure 7: Reference image for Task 3

5. Report

Your lab report should include:

- Signed lab report cover page: http://www.ryerson.ca/mie/documents/
  (make sure you put your lab group number on the front)
- Abstract
- Introduction
- Experimental Equipment (ie. what was used)
- Description of the Program with Flowchart
- Tinkercad Model of the Circuits
- Conclusions & Recommendations
- Appendix: Program Listing
- Report file name convention:
- Report_[Section#]_[Student_ID]_ [Last_Name}_[First_Name]_LAB1.pdf, e.g. Report_09_00099887766_Smith_John_LAB1.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]_LAB1.pdf, e.g. Code_09_00099887766_Smith_John_LAB1.[c, zip]

- Lab reports are due in 1 week since your lab session starts.
- Submit to D2L→ Assessment → Assignment → Lab3
- Late submissions will be penalized at a rate of 10% per day, where weekends count as two days for online submission.
- Each student should submit his/her own individual report/work. This is not group work.
- Lab attendance is mandatory. If you submit a report without attending the lab, you will get zero marks.
- Weight:
  - 50%: TA confirms that you did the lab during the lab hour
  - 50%: Lab report and the code