# ECE 4950 Project 1

**Configuring a Real-Time Workstation / Introduction to the Laser Cutter**

**Safety: All laboratory activities must be done keeping safety in mind. If you are not sure about the safety of an activity, stop work and consult the TA or instructor. You will never be penalized for stopping an activity because of a safety concern. You must wear safety glasses for all laboratory work requiring close contact and moving/potentially fissile parts.**

## Goals

1. Become familiar with the ECE 4950 class structure including software and equipment.
2. Investigate the MATLAB/Simulink real-time software and the Arduino for future use in the design project.
3. Appreciate the laser cutter as a rapid-prototyping tool for mechanical parts. Learn to rudimentarily use AutoCAD/SolidWorks.
4. Develop structure and working relationships within project group.

## Project Overview

1. **Each group will test their system by interfacing a sensor and actuator.** The system developed by the teams will use an analog sensor to trigger an electromagnet. The threshold for the sensor will have to be variable to allow for changes upon request by the user. Note that you will not be able to connect the electromagnet directly to the Arduino. You will have to research safe interfacing of the electromagnet to the Arduino and report on your findings and method along with any design considerations and component choices.
2. **Each group will design and fabricate a small acrylic part using a laser cutter.** You will have to design the part in AutoCAD/Solidworks using the template posted on Canvas.

The student-supplied laptop will be needed to operate the real-time control workstation (be the Host). In order to ensure that the group has a Host available for the project at all times, it is recommended that each group configure multiple Host computers identically.

## Experiments

Testing the Sensor and Actuator

1. An analog sensor will be picked by the team. The sensor should not provide discrete information. One example is a force sensor. The team will have to demonstrate the ability to read sensor data in Simulink.
2. Teams will be provided with an electromagnet actuator to interface. The electromagnet will have to be actuated by the team using Simulink to better understand its working and capabilities.

A Simulink block diagram will be created to energize (or deenergize) the actuator based on crossing a sensor threshold. The threshold and choice to energize/deenergize can be chosen by the user. Save Simulink scope data demonstrating crossing sensor threshold levels and energizing/deenergizing the actuator for your report.

Using the Laser Cutter

1. Install AutoCAD on a student laptop. This does not necessarily have to be the same laptop used for the real-time control. Alternatively, Solidworks may also be used.
2. Follow the rules provided on Canvas to create a part to be cut with the laser cutter. The part should demonstrate both cutting and etching. The part needs to have the group name/number on it in a readable font size. The part should be contained in a 4” x 4” cutting area and will be graded partly on the creativity of the design. Use your imagination. Submit this file along with your Project 1 document.

# ECE 4950 Project 1 – Research Report Rubric

Each group will create a report that will eventually become a section in the **“Research”** section of your final project website. Use the guidelines below to complete your report and add at the end of your report.

Group Member Last Names:

|  |  |  |  |
| --- | --- | --- | --- |
| Score | Pts |  | Perfor mance Indicat  ors |
|  | 15 | **General Format - Professional Looking Document/Preparation (whole document)**   1. Fonts, margins (11pt, times new roman, single spaced. 1" margins on all sides). 2. Spelling and grammar are correct 3. Layout of pictures – all figures need numbers and captions and must be referenced in the text 4. Follows the page limitations below. 5. References (if any). Use IEEE reference format. 6. This grading sheet is included as the final page. | g.1 |
|  | 20 | **Page 1: Title, Group Name, Group Members, and Date Executive Summary** (~1/3 of the page)  Provide a brief summary of the whole experiment. Use language that targets **a non- technical audience**. An important skill for an engineer is to communicate complex technical information to a general audience that may be involved in decision making,  e.g. marketing. Important criteria:   * 1. Can a non-technical audience (~ high-school degree) read this section and understand your goals, procedures, and conclusions?   2. Use simple words and graphics to help explain | g.1 |
|  | 40 | The next sections of the report follow the standard **laboratory report format**.  **Page 2: Materials and Methods for the Sensor/Actuator Experiments (don’t need to describe the laser cutter)** (< 1 page)  You are establishing the credibility and usefulness of your results by providing all the details so that someone else could repeat your experiment. As an example, MATLAB 2011a may behave differently than MATLAB 2010b – the software version information which would be required to reproduce your result should be included. This section should answer the following:   1. What equipment is used (i.e. real-time workstation), include software versions. 2. How were the experiments conducted? How is the equipment connected and used? Describe the instrumentation, special cables (if any), connections, and experiments using diagrams and photos.   **Pages 3-4: Results and Discussion for the Sensor/Actuator Experiments** (< 2 pages) Describe what you have done. Include plots for all the experiments and a brief discussion of how you interpret the results. Did you demonstrate (through your documentation) that the equipment has been configured and used correctly?  **Page 5: Conclusions and References** (< 1 page)   1. Based on this experiment, do you recommend this equipment for use in a robot control project? What are the possible limitations? Your results and   observations should be the basis for your conclusions. (~1/2 page)   1. What are the possible uses for the laser cutter in your projects? (~1/4 page) | k.2  k.2  k.2 |
|  | 5 | **Page 6: This Grading Sheet** | g.1 |
|  | 20 | **Laser Cut Part File** Grading based on:   1. How well does this part demonstrate the capability of the laser cutter to make prototype parts for an automated (robotic) system? 2. Originality and creativity | k.2  i.1 |