

## Resource R1 High-level embedded system

The Embedded Computing Laboratory (ECL) at Saint Martin's University is a space dedicated to teaching embedded computing in electromechanical systems. It is hosted by the Robotics Laboratory and developed in collaboration with Prof. Joe Garbini of the Department of Mechanical Engineering at the University of Washington (UW), to whom credit for much of the design is owed.

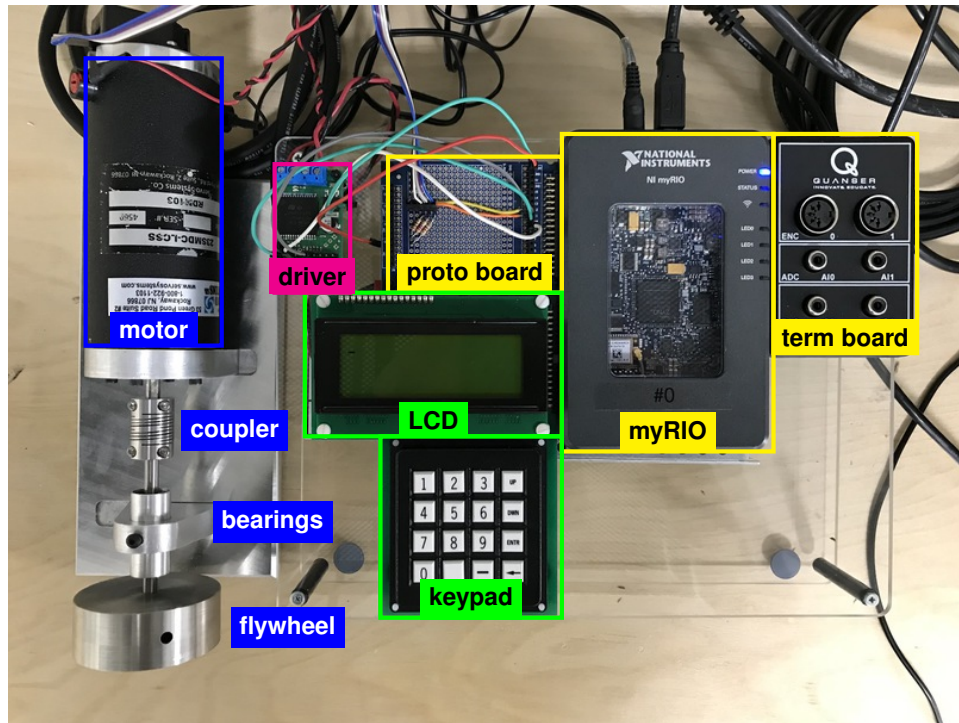
The following description is of the apparatuses at ECL, which are similar to those at the UW. The primary differences are that each lab has a different set of motors and the UW uses a custom analog amplifier to drive the motor whereas the ECL uses pulse-width modulation.

The developers of the following content distribute it in the hopes that others will find it educational and perhaps useful as a template for similar laboratories. Furthermore, we hope students will be able to reference it when they want to design their own embedded systems.

ECL has four identical systems for student use. Each system consists of four subsystems:

1. an *embedded computer and development environment subsystem* consisting of a National Instruments myRIO microcontroller, a personal computer, and the Eclipse IDE;
2. a *user interface hardware subsystem* consisting of a keypad, LCD display, and associated circuit boards;
3. a *motor driver subsystem* consisting of a dc power supply and a pulse-width modulation motor driver circuit board and
4. a *motor and mechanical apparatus subsystem* consisting of a flywheel supported by bearings and coupled to the shaft of a dc servomotor (with encoder for feedback).

Each of these is described in detail in the following sections. Together, they allow a student to program the microcontroller (in the C programming language) to instantiate completely embedded control of the motor speed and position, which are set by the user through the keypad and LCD display.



**Figure 00.7:** top view of most of the ECL apparatus.



**Figure 00.8:** front view of most of the ECL apparatus.