ETD555 – Engineering Technology & Design
Team Design Project

Project Background

This course focuses on preparation for the final capstone project in TPJ655. Part of that preparation is to provide a solid foundation in electronic technology practice routinely needed in these projects and beyond.

To that end, we have been closely examining principles involved with interfacing between microcontrollers (MCUs), or other low voltage controller devices (such as the LabJack UE9), and external devices such a practical DC loads, switches, sensors, etc. This exploration has (and will) included:

- programming devices (such as the LabJack UE9) to perform analog and digital Input & Output (I/O)
- switching, Pulse Width Modulation (PWM) and H-Bridge driving of loads using low and high power BJTs, MOSFETs and driver ICs
- level shifting and signal conditioning to accommodate varying voltage level needs
- optical isolation as a means of realizing noise reduction, safety and device protection
- sensors (such as opto-slot sensors) and switches as a means of feedback to inform program control
- SPICE simulation (in OrCAD 16.6 Lite) as a means of schematic capture and testing circuit concepts
- Printed Circuit Board (PCB) design using EDA tools (such as PADS Logic, Layout & Router)
- team work and project management in solving problems and as tools to more effectively realize project outcomes

All of these skills (and more) will now be applied in a team design project.

Project Description

You have been assigned to work in a team to design, construct, test and deliver a board which interfaces with a PC through the LabJack UE9.

The board will satisfy the following requirements:

- interface with the LabJack UE9 which is programmed from a PC Integrated Development Environment (IDE) Anaconda Python 3.6 to provide digital & analog input & output using an appropriate program interface
- provide drive capabilities for a large DC motor load running on at least +12VDC
- provide suitable optical isolation between the LabJack and the load/board
- provide motor *direction* and *speed control*
- provide on-board safety controls using two momentary push buttons: one emergency stop switch which immediately stops the motor, and one reset switch which will enable resumption, provided the user *also verifies a prompt from the program*
- the interface board is constructed on a finished Printed Circuit Board (PCB)
- it must be demonstrated with a working load in A4070 lab at Seneca

Optional characteristics may include the following:

- 3D printed plastic component (designed in SolidWorks), such as a PCB bracket, motor mount, etc.
- continuous motor temperature measurement & display
- continuous motor DC current measurement & display (**NOTE**: current measurement *must be isolated* from the LabJack UE9 in order to protect it)

Each team will bear the cost of any components amongst the members. The total cost should not be excessive, but this constraint will definitely figure into your design considerations.
The project deadline is in your final *regularly scheduled lab class* (**Wed. Aug. 8 or Thur. Aug. 9**) where your team will give a short Power Point presentation and demonstration (*maximum* **15 minutes total**).

As per the course outline, the *total project mark* is worth ***20% of your final ETD555 mark***.

Deliverables
The following are the *project deliverables*:

- one project proposal *per team* (as listed below in Phase 1 Assignment)
- demonstration of a working solution by the specified due date in A4070
- one **type written, *double spaced***, report *per team* which includes fully labeled block diagrams, schematics and PCB design, operation instructions, test procedures & results, Bill of Materials (BOM) including costs, difficulties encountered and solutions, overall analysis of the project (what worked, what didn't), and recommendations for project extensions
- one group PowerPoint presentation per team

Phase 1
You have been assigned to a project team. You should *meet as soon as possible* to begin researching how your team can best to tackle this design challenge. Exchange contact information and agree on good times to meet. Divide up any tasks equally among the team members so nobody ends up doing all the work.

Someone must take on the important task of *secretary* for each meeting. It is best if this task circulates among members so everyone takes their turn. The secretary's job is to record the following *minutes of the meeting* (*point form is OK*):

- prepare an agenda *before* the meeting (a list of what will take place in the meeting)
- time, date and place of the meeting plus a list of attendees
- what is discussed and tried during the meeting
- what must be done and by *whom* for the next meeting (**action items**)
- time, date and place for the *next* meeting

The secretary must type up the meeting minutes and make them available to the team within 24 hours. WhatsApp, Google Docs and/or Google Drive (or similar) can prove very useful in facilitating team communications.

Phase 1 Assignment
Recall that a project proposal serves to gain support for the project and make a case for its viability and usefulness. Without a solid proposal, the project won't even get off the ground.

Each team will submit a ***type-written, double-spaced*** *proposal* for the project including the following:

- problem statement: exactly what is the problem to be solved?
- outline of the project: summary, scope statement, goals, objectives, deliverables, strategy, block diagram for the proposed design solution (schematics are not necessary at this point)
- general plan for what is to be done, by whom and by when (to be refined later)

All team members must participate in producing the proposal. *The entire team will share in the mark*.

Include a copy of one of your team's meeting minutes at the end of your proposal.

A *hard copy* and e-copy of the team proposal is due in *the lab class before reading week* (**Jun. 19** *or* **Jun. 20**)