ECE 102 LabJack / MATLAB Project Guide v1.1

Project Goal

Student teams will apply their knowledge of MATLAB to produce a program that controls a LabJack. Central concepts include real-time hardware interfacing and the software development process.

Team Selection

- Each team should consist of **two** people.
- Teams with more than two people are not normally allowed, except under the following condition: With only 30 LabJack devices available and over 60 students registered for the course, some teams may be permitted to have three people.
- Teams with only a single person are not allowed (unless there are sufficient LabJacks).
- Students should decide who they wish to be partners with before **Feb. 24, 2010**.

LabJack Kit

Each team will be issued a LabJack kit that contains the following parts:

- LabJack U3-LV or U3-HV
- Protoboard
- Light Emitting Diodes
- Momentary contact switch
- 10K Ω resistor, 1 µF ceramic capacitor (for debounce circuit)
- Connection wire

Important rules:

- A team must sign out for a kit.
- A team may keep the kit outside of the lab (e.g., at home) for the duration of the project.
- At the end of the project, the kit must be returned in good working condition.
- Losing or damaging parts in the kit (especially the LabJack or protoboard) is very, *very* bad. ***You may be held financially responsible for kit damage or loss.***
- If a team feels uncomfortable about keeping a kit outside of the lab, then the members may ask to check out a kit at the start of the day and then return the kit before the end of the day. This needs to be prearranged with the instructor.
- If a team does not return a kit on time and in good condition, then each team member's final course grade will be withheld until the situation is resolved.

Description of Core Project

Part 1: Hardware

Using your parts, do the following:

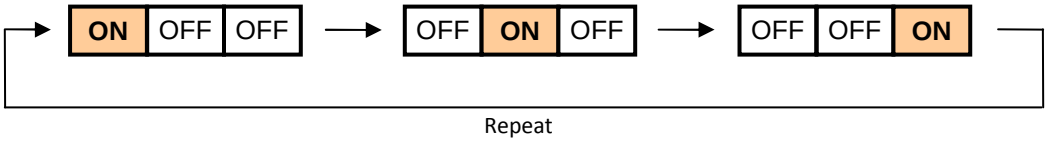
1. Arrange three LEDs in a row on the protoboard. The LEDs are not connected to each other.
2. Connect each LED to its own digital I/O line on the LabJack. Use FIO4, FIO5, and FIO6.
3. Add a momentary contact switch and debounce circuit on the protoboard.
4. Connect the switch to its own analog input line on the LabJack. Use FIO7.
5. If needed, you may use the VS (+5 V) and GND terminals on the LabJack.

Part 2: Software

Write a MATLAB program to control the LabJack and perform these tasks:

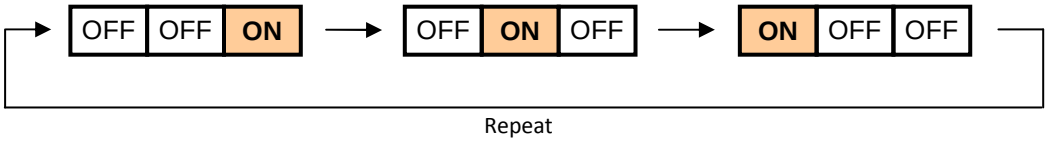
1. The program lights each LED in sequence, starting with the "Forward" sequence.

   Forward LED Sequence:



2. If the contact switch is pressed and released, then the program should light the LEDs using the "Reverse" sequence.

   Reverse LED Sequence:



3. Each time the switch is pressed, the LED sequence should switch its direction.

For the core project, each LED should stay "ON" for about 1 second.

Description of Extra Credit Mini-Projects

- Extra credit is optional.
- Extra credit will not be accepted unless the core project works correctly first.
- You may choose to do one or more of the extra credit mini-projects.
- The added code needs to be integrated into the core program.

Mini-Project 1: Adding Sound

Add a short tone that plays through the host computer's audio output port each time the program steps to the next LED in a sequence. *Hint:* Look up the MATLAB "sound()" function.

Mini-Project 2: Adding variable ON time

Prompt the user for how long the LED should be ON before stepping to the next LED. The allowed time values are between 0.25 and 3 seconds. Modify the core program to utilize the user's desired ON time.

Mini-Project 3: Using LEDs to count in binary

With three LEDs, there are $2^3 = 8$ possible states:

Decimal	Binary	Decimal	Binary
0	000	4	100
1	001	5	101
2	010	6	110
3	011	7	111

Write a function that, when passed a decimal number between 0 and 7 inclusive, will display the equivalent binary value on the LEDs. Incorporate this into the program as an alternative sequence generator (ascending or descending count, depending on the switch press).

Mini-Project 4: Using a photocell to stop the program

Add a photocell[1] circuit to your protoboard and connect it to an I/O line on the LabJack. Modify your program so that the following situation is handled:

- If the photocell is exposed to standard room lights: program should run normally
- If the photocell is covered (i.e., kept in darkness): program should terminate

Warning:

Keep the project deadline in mind. A smaller project that works is better than an incomplete larger project. Do not overburden yourself with mini-projects if you have insufficient time to complete the required work. Save a separate, functional copy of the core project as a backup.

[1] A photocell is a light sensing device whose resistance varies with the amount of incident light. The photocell is not part of the standard LabJack kit. Ask the instructor for the part, but only if you intend to do this mini-project.

What to Submit for Grading (Finals Week)

Live Demonstration

- There will be time blocks each day during finals week (Monday (3/15) to Thursday (3/18)) that you can come to the lab to demonstrate your project. Details will be announced later.
- Bring your LabJack kit and final report.
- Be ready to run your MATLAB file and prove that each project specification has been met.
- At least one team member is expected to show up for the demonstration.

MATLAB Program

- There should be a comment block at the beginning of the program with the following information: Team member names, Course number, Date, and Description of the program
- The code should be documented with appropriate comments.
- The code should use good programming techniques (e.g., descriptive variable names).
- Whenever possible, utilize MATLAB functions/subroutines to make the program modular.
- Try to write efficient code.
- Send one copy of the MATLAB program (scripts, functions) as attachments in an e-mail message to the course address (taeas102@ece.pdx.edu) before 12pm on Thursday, Mar. 18, 2010.
- Use this format for the subject line of your message: *ECE102 Project Your Name*

Program Design Report

- The final report should include the following:

  Description of the Problem
  Here you need to concisely explain the problem to be solved or task to be performed. Do not just copy the problem descriptions from this document. Write this in your own words.

  Description of the Inputs and Outputs
  In this section, the program's expected inputs and outputs are listed. The descriptions should be simple and clear. Explain any boundary conditions that are imposed on the inputs or outputs.

  Design Approach and Assumptions
  You should outline your basic approach to writing the program. Provide enough details to give the reader a general idea of how your program works, and state any assumptions you made. Include a flowchart for your algorithm.

- Include a drawing of the circuit schematic that illustrates how you constructed and connected the components to the LabJack.

- The report should be 3 to 4 pages long (8.5”×11”, normal margins, 11 point font, single-line spacing).
- Use the technical report format that was discussed in the course lecture.
- Include any data sheets or other reference material in the appendix section of the report.
- Submit a printed copy of your report to the instructor on the day of your project demonstration.

Grading

60 core project points are possible. All members of the team receive the same grade.

5 pts	LabJack In-Class Exercise #1
5 pts	LabJack In-Class Exercise #2
25 pts	MATLAB source code
15 pts	Program Design Report
10 pts	Core program performance (Demo: 0 = doesn’t work, 5 = partially works, 10 = completely works)

Up to 15 extra credit points are possible.

3 pts	Adding sound
4 pts	Adding variable ON time
4 pts	Using LEDs to count in binary
4 pts	Using a photocell to stop the program

- Extra credit will not be accepted unless the core project works correctly first.
- There is no partial extra credit – each mini-project must work correctly to receive points.
- Extra credit points are added to the core points up to the maximum 60.
- Any left-over points will be added to the total quiz score.

Warning: A team member who does not perform his or her fair share of the work, or does not provide any meaningful contribution, will receive a reduced or failing grade for the project.

If you are having problems working with your partner, please try to resolve it among yourselves first. If that is not possible, then talk with the instructor and present your case.