FACULTY OF ENGINEERING AND APPLIED SCIENCE

ENGR 3390U
Mechatronics

Mini-Project 6

Load Cell Labview Application

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1. Introduction

The purpose of this mini-project is to provide exposure to data acquisition through the creation of a digital scale. You will be required to read in an analog signal from a load cell to the computer through a provided Data Acquisition (DAQ) board. You will use LabVIEW to interface with the DAQ board and to read in the signal from the load cell. In addition, you will be required to design a filter to perform signal conditioning on the measured signal and convert it to the appropriate weight.

2. Hardware and Software

2.1 Hardware

The hardware available for the mini-project includes:

- Dell Dimension 9100 Computer
- National Instruments PCI-6052E Multifunction DAQ Board
- National Instruments BNC-2110 Terminal Block
- Omega LC302-25 Load Cell in Custom Built Enclosure
- Custom Built Power Conditioning Circuit with Power Supply
- Commercial Digital Scale
- Set of Weights
- BNC to Alligator Clip Cable

Figures 1 and 2 show the National Instruments PCI-6052E board and BNC-2110 terminal block respectively. A data sheet for the PCI-6052E can be found on

WebCT, or at www.ni.com (serach 6052E). The PCI-6052E should be connected to the BNC-2210 through the provided BNC to Alligator Clip cable.

Figure 1: National Instruments PCI-6052E DAQ board.

Figure 2: National Instruments BNC-2110 terminal block.

Figures 3 and 4 show the load cell apparatus. A data sheet for the load cell can be found on WebCT, or at www.omega.com (search load cells, LC302-25).

Note that the maximum load that can be applied to the load cell is 25 lb, therefore:

WARNING: Do not apply loads greater than 25 lb to the load cell.

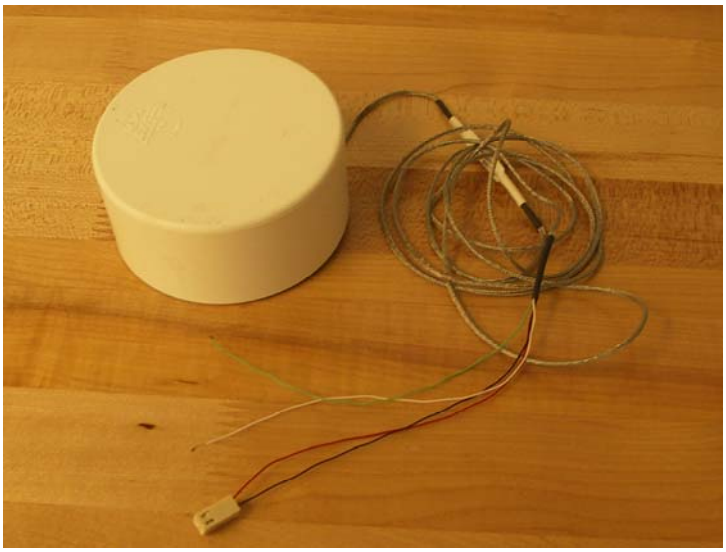

Figure 3: Load cell apparatus.

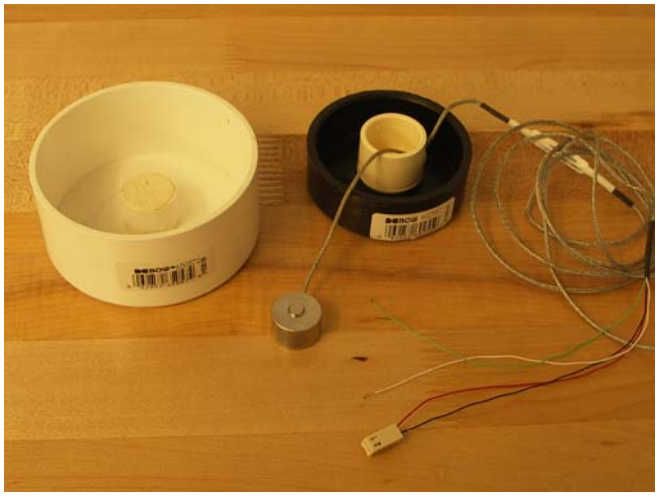

Figure 4: Omega LC302-25 load cell with the custom built enclosure open.

Referring to Figures 3 and 4, the green and white wires carry the analog signal from the load cell. The green and white wires should be connected to the AI 0 channel on the BNC-2110 and the input should be set to Floating Source (FS).

Figure 5 shows the custom built power conditioning circuit. The power conditioning circuit is mounted on the mechatronics board (see Figure 6). The

red and black wires from the load cell should be connected to the pins on the power conditioning circuit as shown in Figure 5.

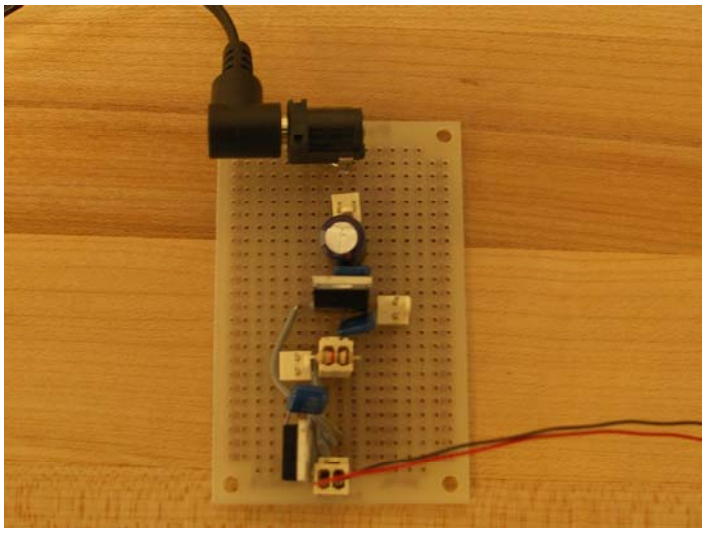

Figure 5: Custom built power conditioning circuit.

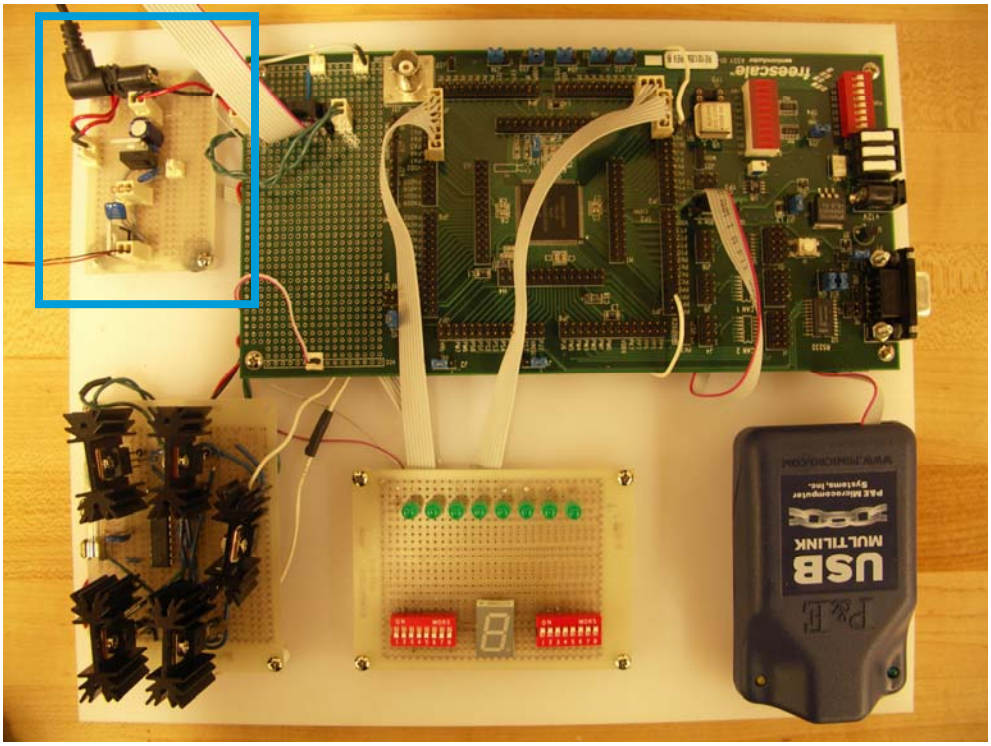

Figure 6: Mechatronics board (the item in the blue box is the power conditioning circuit).

Make sure that power is supplied to the power conditioning circuit.

2.2 Software

The following software is installed on the laboratory computers and is available to complete the mini-project:

- LabVIEW

Software manuals for LabVIEW, MATLAB, Simulink, and the Data Acquisition Toolbox can be found on the course WebCT site.

This manual is not a substitute for the manuals and online help for MATLAB, Simulink, and LabVIEW. You will need to consult the documentation in order to complete this mini-project.

3. Pre-Project Requirements

3.1 Pre-Project Responsibilities

Prior to your lab time, it is recommended that you study some of the LabVIEW tutorials at the following links:

http://www.mech.uwa.edu.au/jpt/tutorial/ieindex.html

http://www.iit.edu/~labview/Dummies.html

http://www.cipce.rpi.edu/programs/remote_experiment/labview/

http://www.ee.buffalo.edu/faculty/paololiu/edtech/roaldi/tutorials/labview.htm

http://www.upscale.utoronto.ca/GeneralInterest/LabView.html

More tutorial links and training videos are listed in the following document:

http://wiki.lavag.org/LabVIEW_tutorial

LabVIEW provides Resources that include: Getting Started with LabVIEW and LabVIEW Fundamentals.

Note that you will not be able to execute the Data Acquisition Toolbox commands until you are in the lab, if you wish to use the DAQ NI 6052E. However, you can design and test your software either using the sound card integrated in your laptop, or by using a simulation block in your Labview application and set it up to produce data.

In addition to the above, you must review the supporting documentation provided, i.e., review all equipment data sheets and software manuals.

3.2 Pre-Project Deliverables

You must submit a short document that includes your draft LabVIEW program complete with data acquisition, data scaling and offsetting, and data filtering. Include simulation results of your filter design.

You must complete all pre-project requirements before your scheduled lab time and submit a copy of your pre-project deliverables (one copy per group) to the TA at the START of your first lab session for this mini-project.

4. Mini-Project Requirements

4.1 LabVIEW Requirements

You are required to create a LabVIEW VI (Virtual Instrument) for measuring the signal from the load cell and converting it into a measured weight, thus creating a digital scale. You must use the built-in signal processing functions of LabVIEW to filter noise from your analog signal.

Use the commercially available scale to compare the results you obtained with your LabVIEW implementation and the actual value of the weights.

In addition, experiment using different cut-off frequencies in your filter and note the effects it has on your results.

You must demonstrate the functionality of your LabVIEW VI for measuring weights to the TA before the end of your scheduled lab time allocated for this project.

You must remove all of your files from the lab computers at the end of each lab session. Make sure you save a copy of the files to your laptop before you delete them from the lab computers. Files can be copied using a USB flash drive. Failure to remove your files will result in a zero mark for the mini-project in question. Repeat offenders will receive a zero mark for the mini-project component of the course.

Sharing of files between groups is NOT permitted and will result in Academic Misconduct charges.

4. 3 Report Requirements

You must submit one report per group that documents your design. The report must be in the form of a **technical report** and should include:

- title page
- group members signing sheet
- table of contents
- executive summary
- project definition
- requirements section (state what you must do)
- engineering specification section (state the gain and offset values you have determined in the lab, that must be applied to your raw acquisition data, that would allow you to display a weight of 0 and the weight of a calibration mass provided to you in the lab)
- concept generation section: flowcharts, pseudo-code, program files (include only the program files in an appendix)
- test plan / scale calibration section (to test, you may need several calibrated weights, if available. Also, to be able to magnify your plots and show the measurement noise level, you may want to turn autoscale off for the y-axis for your log plots. State all this in the test section)
- discussion and analysis of your prototype demonstration
- conclusions
- provide as appropriate: freehand sketches, analytical calculations, references, etc.

4. 4 Submission Requirements

Your submission must comply with the following:

- Maximum of 20 pages of project text (1.5 spaced, font Time New Roman, size 12) excluding appendices and drawings (the number of drawings is not limited in any way) and a CD/DVD with electronic copies of all files.
- Use appropriate project table of contents and formatting. Please state appropriately the references used (use the following link for guidance: http://www.ecf.toronto.edu/~writing/handbook.html).

5. Marking Scheme

The overall mini-project will be marked for: completeness, technical merits, clarity, quality of engineering analysis, feasibility of the proposed design concept, and the functionality of the prototype.

The report will account for 40% of the mini-project mark. The pre-project requirements will account for 30% of the mini-project mark. The prototype demonstration will account for 30% of the mini-project mark.