

Homework #6

LabVIEW

Dr. Pogo

Assignment is due on Tuesday, October 24, 2023

Assigned October 12, 2023

Assignment #6: Digital Data Acquisition

Controls: A “buzzer mute” switch, a stop button, and a configure button
A mode switch, plus two dials and one switch to mimic the external inputs

Indicators: Two active voltage indicators
4 panel lights (red, green, yellow, purple)
‘Daq found’ and ‘Daq not found’ indicators

Operation: Requires a DAQ, the prototype board (but see other side), and two analog voltage sources.

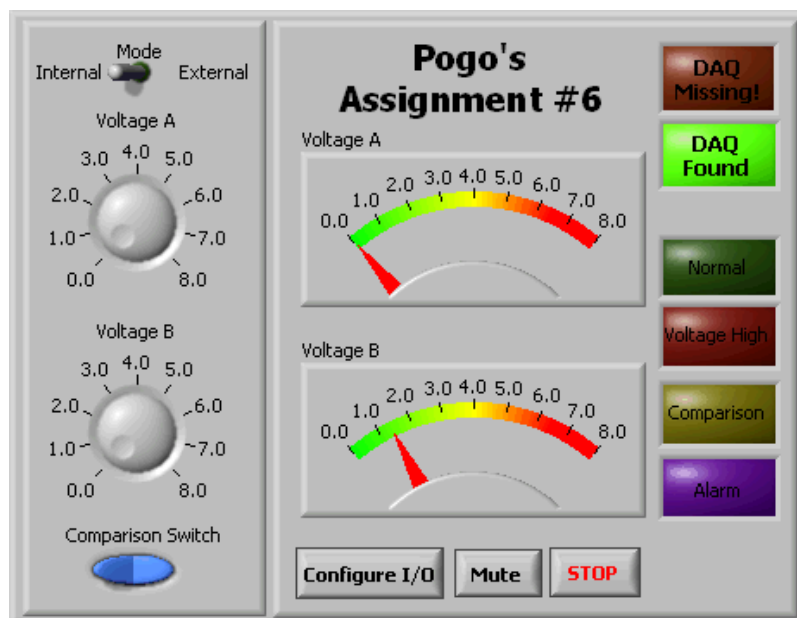
This is a difficult assignment. It will REALLY pay off to consider structural issues before you begin coding: determine what loops and structures will be located where and activated when. Where do you need shift registers?

The Mode switch selects between using the external hardware or their onscreen versions. The two ‘Daq found’ indicators should initialize off, and the program should initialize in “internal” mode. When in ‘internal’ mode, the program should run even if the DAQ is missing. Each time the user **switches to** “external” mode, the program should attempt to discover the Daq, and then start it for both digital I/O and Analog input (if it is found). The program should revert back to “internal mode” if the DAQ is not found. When the stop button is pressed, all the LED’s, lights, and buzzers should be turned off on both the hardware and the screen before the program stops (except the ‘DAQ Found’ or ‘DAQ Missing’ lights). The “Case” for a **change** from internal to external mode is at least as important as the “Case” for just being **in** internal or external mode. Failure to recognize this is a common error. All DAQ Tasks should “Daqmx Stop Task” when changing from external to internal mode. There are SEVERE penalties for **Restarting** the DAQ when already in external mode!

The program will monitor two voltage signals that may each range between 0 and +8 volts. If both signals are under 5 volts, the green LED should be on (on both the panel and the prototype). If either voltage is over 5 volts, the red lights should be on. While the channel B voltage is larger than the channel A voltage, the yellow lights should be on (when the prototype switch is *up*. When the prototype switch is *down*, the yellow lights should come on when the channel A voltage is larger than the channel B voltage). If the yellow light ever changes from off to on, it must stay on for a minimum of 2 full seconds, even if the voltages return to their prior condition during that time. After 2 seconds, the yellow light should go off only if the voltages have returned to their prior condition.

If the sum of the two voltages is between 12 and 14 volts, the purple LED should light, and the buzzer should sound. However, if the buzzer mute switch is active, then the buzzer should not sound (but the purple light should remain on). Similarly, if the sum of the two voltages is between 14 and 16 volts, both the purple LED and the buzzer should continuously “blink” (1 second on, and 1 second off). The buzzer is still subject to the mute switch in this case. While in external mode, if the prototype switch is changed, the onscreen switch should change as well.

The configure button should call a pop-up dialog to allow the user to specify which pins of the daq the prototype is connected to. It may only be used while in “internal” mode (use a warning dialog if the user attempts to reconfigure the wires while in external mode). You may use my “configure” subVI, but I will not explain what it does or how it works. Your program will NOT be tested at all using the default configuration values, so you better make sure your digital inputs and outputs actually work for more than one random configuration, changed while the program is continually running.



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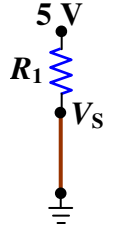
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Notes if working from home:

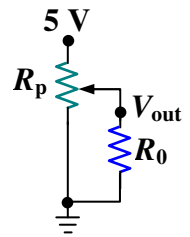
- Technically, you do not really need the prototype board to test your circuit. The bare minimum of what you need is a voltmeter and a 5V power supply. The 4 outputs (each LED and the buzzer) can each be checked by hand with the voltmeter. If you see a value between 4 and 6 volts, the LED (or buzzer) would be on. If the value is between -0.5 and +0.5 volts, then the LED or buzzer would be off. If the voltage is something else, you messed up!
- Similarly, you can use any simple 5 volt source to test the “comparison” switch using the circuit shown here. V_S is connected to the digital input representing the switch by another “blue” wire not shown here. In this circuit, pick any R_1 bigger than about 1 k Ω . Then, you either pull the brown wire out, or not. When the brown wire is present, then $V_S = 0$ V. When the brown wire is removed, then $V_S = 5$ V.
- Here’s another way to do the comparison switch: Use your screwdriver to tighten the screw corresponding to the digital channel specified for the blue wire on the physical DAQ (e.g., p0.5). Then, attach a short (5 or 6 inch) wire to the digital ground of the DAQ. Then, touching (vs. not touching) the other end of this short wire to the screw representing the blue wire will be equivalent to physically manipulating the switch on the prototype board.
- If you don’t have access to two variable DC power supplies, you can make two analog voltage controls using two copies of this circuit:



You can use the +5 output from the DAQ to get started, or any other constant power supply.

The output of the circuit shown here is V_{out} , which you connect to an analog input of the DAQ. Choose a value for R_0 that is at least as big as the total resistance R_p of the potentiometer.

When the “slider” is at the “top” end of the potentiometer, V_{out} will be 5 V. When the slider is at the “bottom” of the potentiometer, V_{out} will be at zero volts. If you pick larger values of R_0 , the relationship between V_{out} and the potentiometer will become more linear (which is good).



If you are trying to make the same thing, but your constant voltage power supply is not 5V, you can use the circuit shown here instead. To choose R_2 , use this formula:

$$R_2 = \left(\frac{R_0 R_p}{R_0 + R_p} \right) \left(\frac{V_{max}}{5} - 1 \right).$$

Resistance values don’t have to be exact... “ballpark” is fine.

If you chose $R_0 \approx R_p$, then choose $R_2 \approx R_p (0.1V_{max} - 0.5)$

If you chose $R_0 \gg R_p$, then choose $R_2 \approx R_p (0.2V_{max} - 1)$

