

Building a Basic Virtual Instrument (VI)

You will be building a VI that performs the following functions:

1. Data acquisition: Three analog input channels will be captured, corresponding to three simulated sensors.
2. Data conversion and adjustment: The sensor signals are voltage signals. The VI will convert these voltages to physical quantities. Zeroing functions will be included.
3. Data display: The VI will display the measurements in a convenient way, using dial and numeric indicators.
4. User Input: The user will be able to enter instrument sensitivities. Also, slider controls will allow the user to zero the readouts at any time.
5. Data storage: The VI will save the data captured to a text file that can later be opened in Matlab for analysis.

Data Acquisition Settings:

- Start NI LabView and open a blank VI. Two windows appear. One of them is the Front Panel (F.P.), which will contain the user interface and the other one is the Block Diagram (B.D.). Think of the B.D. as an X-Ray image of the F.P.
- On the B.D., select View/Functions Palette from the top menu. Then select Measurement I/O/DAQmx and drag the DAQ Assistant on to the B.D. The DAQ Assistant will open automatically. Select Analog Input and create the input channel on Device 1 (the only one available) using analog input 0 (you will add the other two later). This will be the first measurement, which requires a range from 0 to 10V. Select this and leave the Differential terminal configuration as it is. Change the acquisition mode to Continuous and increase the number of samples to read to 10. Set the sampling frequency to 10 Hz. When you finish, the DAQ Assistant will ask if you wish to create a loop automatically. Accept. Now the B.D. contains a loop (required to keep reading samples until the stop button is pressed). You will see that a stop button has been placed in the F.P.
- Connect the ai0 wires to the 5V source and ground in the protoboard. Do this just to test that the VI is reading the voltage properly. Use the test function in DAQ Assistant. Call the instructor if there's any problem.
- Open the DAQ Assistant and add a second sensor channel. Use ai1 this time, with all other options exactly the same as for ai0. Test the channel by repeating the above step using the ai1 connections.
- Now add a third channel. All parameters should be the same as for the other channels. Test the operation of the third channel.

Data Conversion:

NOTE: ALL BLOCKS TO BE ADDED TO THE B.D. FROM THIS POINT ON MUST BE WITHIN LOOP BOUNDARIES. STRETCH THE LOOP TO A LARGE ENOUGH SIZE.

- On the B.D., display the Functions Palette from the View menu. Click on Express/Signal Manipulation and drag a Split Signals block on to the B.D. Resize the block so that it displays exactly three outputs. Connect the input to the data output of the DAQ Assistant block.
- The first sensor voltage needs to be divided by a sensitivity. Switch to the F.P. and show the Controls Palette from the View menu. Insert a Numeric Control (not Indicator) in the F.P. You will see its counterpart appear in the B.D. Rename the block to "First Sensor Sens.", so the user will know. Right-click, select Properties/Data Range and enter a default value of 0.01.
- Working in the B.D., go to Programming/Numeric in the Functions Palette and find the arithmetic operation blocks. Drag a divider on to the B.D. Wire the top output of the signal splitter to the top input (numerator) of the divider. Wire the output of the torque sensor sensitivity to the denominator input.
- Wire a numeric indicator to the output of the divider and label it "Sensor 1".
- Repeat the above steps for the second channel. This time use a default value of 7 for the sensitivity. Use the third output from the signal splitter, not the second. Display the readout using a numeric indicator as before.
- Repeat for the third simulated sensor, using a sensitivity of 2.
- Now suppose we want to offset (zero out) the measurement from the first sensor.

Delete the wire leading to the numeric indicator associated with Sensor 1. Insert a Subtract block from the numeric area of the palette. Connect the output of the sensitivity block to the top input of the subtraction block and the output of this block back to the numeric indicator. Insert a sliding control and connect its output to the other subtraction block input. Select the range for this slider to be -50 to 50, with increment of 1. It will appear in the F.P.

- Repeat for the second sensor, but use a slider range from -10 to 10 with increment of 0.5
- Arrange everything neatly in the F.P. Don't forget to label every control and indicator.
- Connect Sensor 1 to the board's internal function generator in sinewave mode, Sensor 2 to a constant 5V and Sensor 3 to an additional function generator in a different mode (i.e., triangle wave). Test VI operation from the front panel and call the instructor for verification.

Data Storage:

- Working on the B.D., go to the Functions Palette and insert a Write to Measurement File from the File I/O section. Select Text as the file format, one header only, one column only for the X-axis (time), tab as a delimiter, save to one file, UNCHECK ask user to choose file, and use next available filename.
- NOTE: With these choices, LabView will save using incremental file names. Make sure to keep track of which files contain what when you run experiments.
- Insert a Merge Signals block (right-click on the existing Split Signals block for a quick way to find related blocks) and resize it to show 3 inputs. Connect the output to the input of the Write to Measurement File block.
- Connect the processed sensor signals to the inputs of the Merge Signals block.
- Go the F.P. and insert a push-button control and label it “Save Data”. Working in the B.D., wire the push-button to the enable input of the Write to Measurement File block. Set the mechanical action of the button to “Switch when Released”.

Call the instructor to connect your VI to some real sensors.