MyWeatherStation

PROJECT REPORT

Submitted by

Vipul Jindal-16BIS0018

Varun Agarwal-16BIS0002

Palash Trivedi-16BIS0022

Arun Kumar-16BIS0096

PRINCIPLES OF SENSORS AND DATA ACQUISITION

PROJECT SUPERVISOR

Prof. Debasish Majhi

VIT®
UNIVERSITY
(Estd. u/s 3 of UGC Act 1956)
VELLORE ■ CHENNAI
www.vit.ac.in

November 2017

AIM:
To make a weather station by interfacing a pressure sensor, temperature sensor and a LDR using MyDAQ with LabVIEW and observe changes in LabVIEW.

Objectives:

- To make a weather station to get real time pressure, temperature and intensity of light using the three sensors Pressure sensor BMP 180, Temperature sensor TMP36GZ, LDR respectively.
- Using an Analog Multiplexer to interface more than 2 sensor with MyDAQ as the MyDAQ has only 2 analog inputs and observe the variations in LabVIEW.

INTRODUCTION:

This project guide will take you through the steps in order to make your own weather station using a National Instruments myDAQ, therefore it was only fitting to call this project **MyWeatherStation!**

This project will enable you to understand the fundamentals of data acquisition (DAQ) using LabVIEW as well as implementing a well-known programming architecture often used in LabVIEW applications, the **State Machine Architecture**. The project encompasses analog input and digital output, reading in temperature, atmospheric pressure and light levels.

Required Hardware and Software –

- LabVIEW development environment with the latest DAQmx driver (download the driver at www.ni.com/drivers)
- National Instruments myDAQ and USB cable
- Breadboard
- 9 Volt batteries (or suitable DC power source)
- Wire Strippers and cutters
- Single core wire for prototyping
- Electronic components (listed in Appendix A)

Setting up the myDAQ –
The myDAQ communicates to your computer via USB. To make sure that we have a good connection and that the myDAQ device is recognised correctly we can use the Measurement and Automation Explorer (MAX) to find and configure our myDAQ.

1. Plug in the USB cable into the myDAQ and then into a spare USB port on your computer
2. Locate to Start » All Programs » National Instruments » Measurement and Automation Explorer.
3. Once opened, under ‘My System’ » ‘Devices and Interfaces’ you should be able to see your myDAQ as NI myDAQ “<device name>”. Select the myDAQ and click ‘Self-Test’ on the top toolbar, this will do a hardware check to ensure communications are solid.

Components used in the myWeatherStation Project –

Absolute pressure sensor (BMP-180)–

An Absolute pressure sensor measures the current atmospheric pressure in relation to a vacuum. This means that these types of sensors are ideal for atmospheric pressure (barometer) readings.

The pressure sensor I have used is the MPX5100AP manufactured by Freescale Semiconductor. The sensor gives out an analog voltage between 0 and 5 Volts. This voltage is fed into the myDAQ via a multiplexer and a transfer function is then used within LabVIEW to convert this voltage into pressure.

SPECS:
Pressure range: 300 ... 1100hPa (+9000m ... -500m relating to sea level)
Supply voltage: 1.8 ... 3.6V (VDD)

Transfer Function:

$$Pressure = 11.1112\ X\ \left\{\frac{Vout}{Vs} + \ 0.095\right\}\ X\ 10$$

Where:

Vout = voltage output
Vs = supply voltage (5V)

This transfer function will give out atmospheric pressure in Millibars (mb). To calibrate the pressure I compared my pressure reading with one online for my location. I added 10 mb to my program to be more accurate.

TMP-36GZ

The above sensor is a temperature sensor.It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). It's fairly simple to use, but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds, so when using our library, sensor readings can be up to 2 seconds old.
Transfer Function:

Features and Benefits

- Low voltage operation (2.7 V to 5.5 V)
- Calibrated directly in °C
- 10 mV/°C scale factor (20 mV/°C on TMP37)
- ±2°C accuracy over temperature (typ)
- ±0.5°C linearity (typ)
- Stable with large capacitive loads
- Specified −40°C to +125°C, operation to +150°C
- Less than 50 µA quiescent current
- Shutdown current 0.5 µA max
- Low self-heating
- Qualified for automotive applications

Light Dependant Resistor –

Similar to the thermistor, the light dependant resistor (LDR) is a special type of resistor which changes its resistance dependant on the amount of light that hits it. In this case the output is a voltage between 0V (minimum detected light) and 5V (maximum detected light).

The particular LDR I used to be the VT90N2 manufactured by Excelsis's Technologies.

Analog Multiplexer –

The myDAQ has two differential analog inputs, however this project requires three. As the measurements that need to be taken are between 0 and 5 volts and do not need to be sampled particularly quickly an analog multiplexer was used, giving more inputs.

The analog multiplexer has three digital select lines S0, S1 and S2. Therefore utilising the myDAQ's digital output I attached Digital pins 0-2 to these select lines.

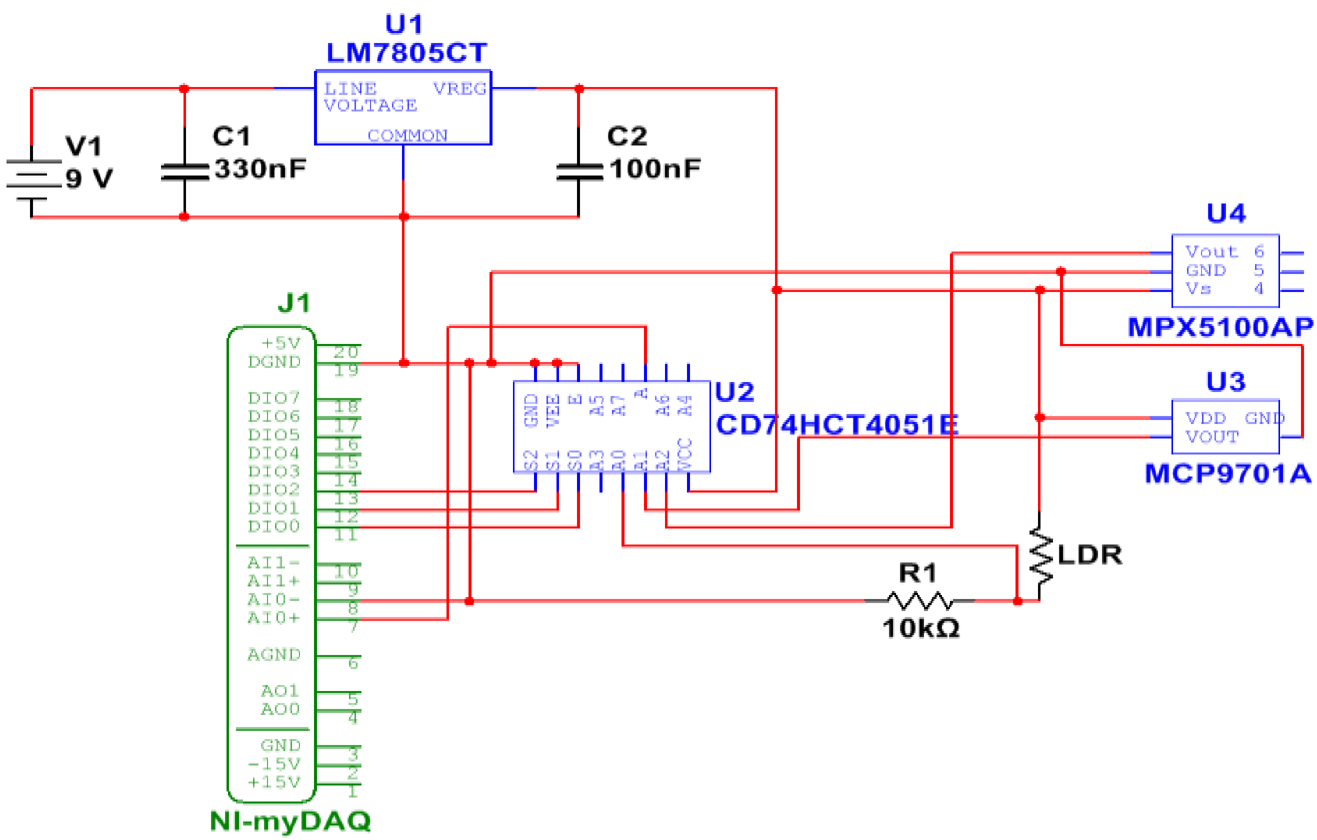
The particular analog multiplexer used was the CD74HCT4051E manufactured by Texas Instruments.

5 Volt Linear Regulator –

To get the most accurate readings from the sensors, a 5 volt regulator allows the integrated circuits a steady 5 volt supply. Linear voltage regulators take in a higher voltage and regulate it down to a steady voltage. In this case a 9V battery has been regulated down using an LM7805 manufactured by Texas Instruments.

The 5V line from the myDAQ can be used; however variations in the supply voltage provided by the computers USB ports will mean that your measurements will vary slightly between computers.

Circuit Diagram –

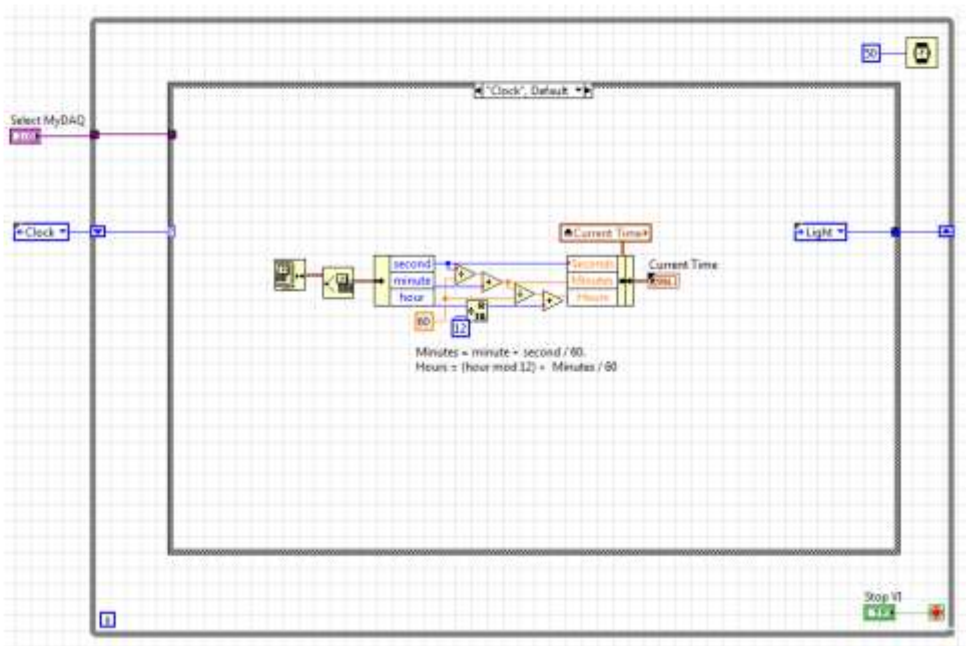


The MyWeatherStation LabVIEW VI –

As mentioned previously, the basis of our LabVIEW program will centre on the state machine architecture, this allows us to sequentially change our digital lines and read and process our data.

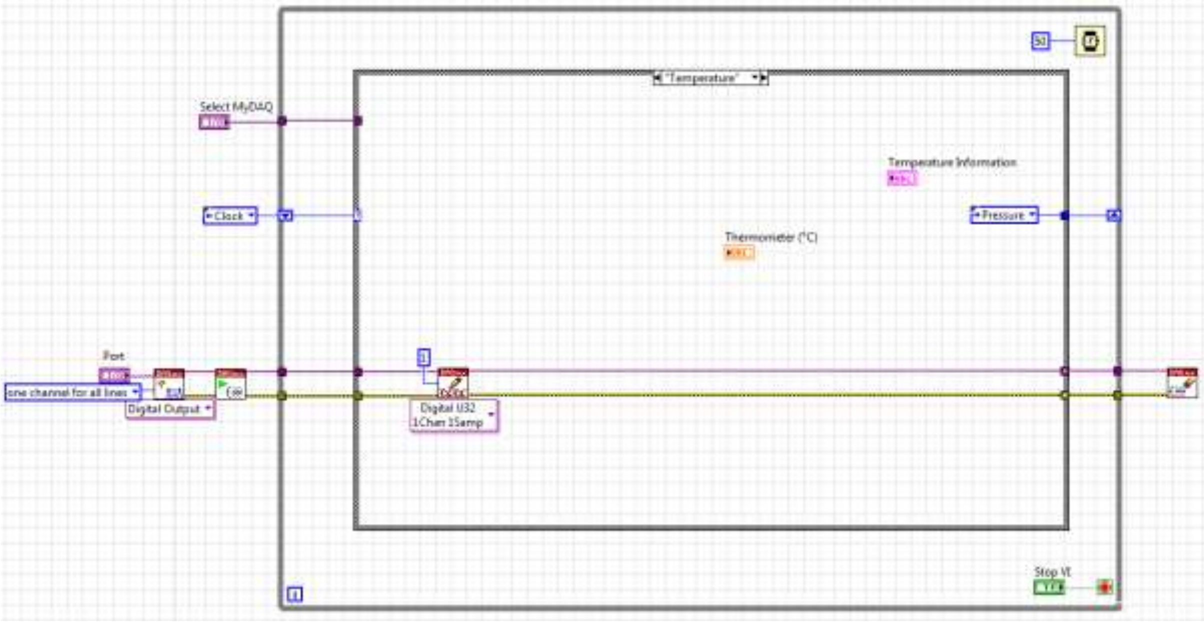
The state machine is basically a single case structure within a while loop, where a type defined Enum and a shift register is used to change states.

1. Go to ‘Start’ » ‘All Programs’ » National Instruments » LabVIEW (<version>) » LabVIEW.
2. On the ‘Getting Started’ page, go to ‘File’ » ‘Open’ and navigate to the ‘MyWeatherStation’ folder and double click on ‘MyWeatherStation_howto. lvproj’.
3. Once this project has opened, double click on ‘Main.vi’ this will open an already made state machine architecture along with a readymade Front Panel



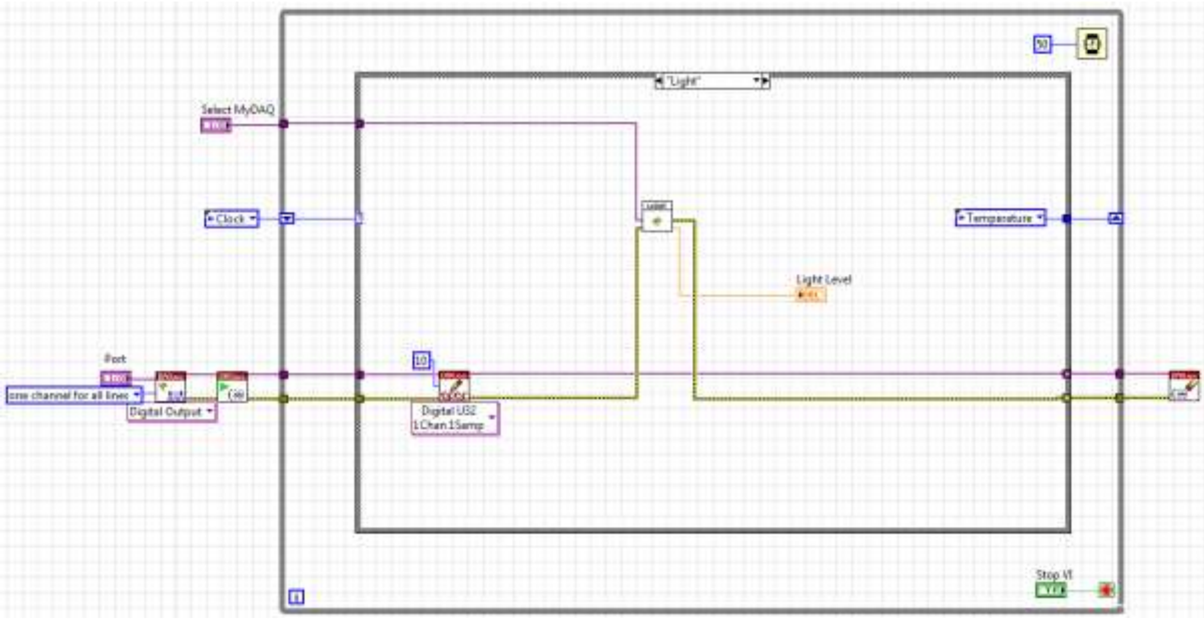
4. Take a moment to navigate around the state machine to make sure you understand how it works.
5. As our analog inputs from our sensors are going through an analog multiplexer, we need to set up the digital switching to switch between our sensors. Refer to the table on what decimal values to write to in each state. Within each state in ‘Main.vi’, set up the digital I/O task for each state.

Once you have done this, your VI should look similar to this:



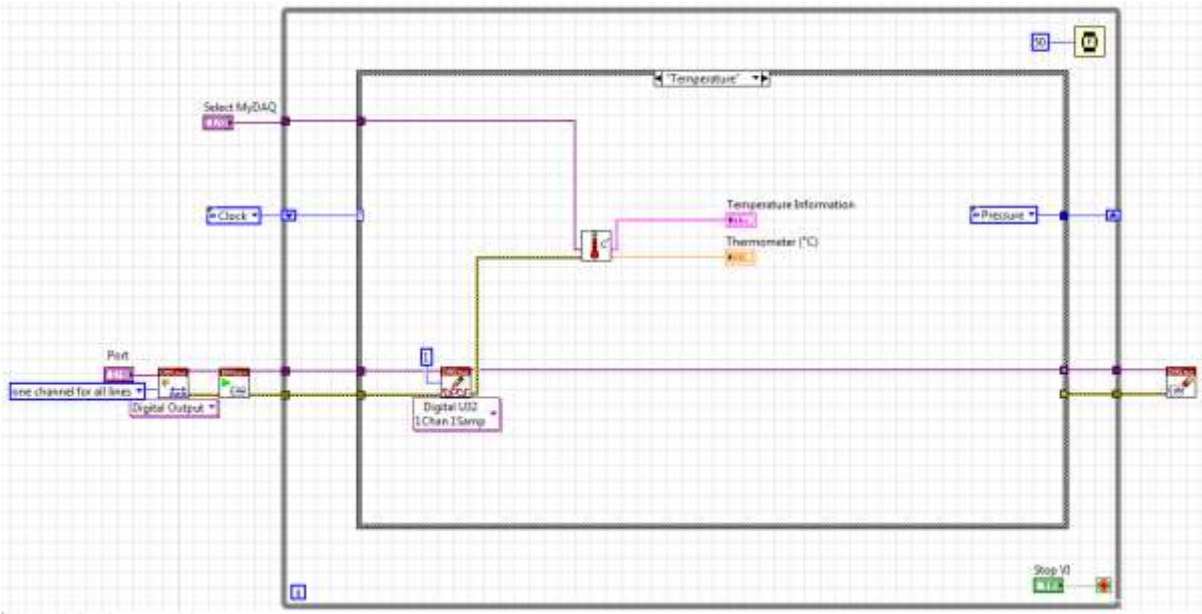
6. Let’s go ahead and complete the ‘Light’ state.

- Navigate to the ‘Light’ State in the case structure; you should see the ‘Light Level’ indicator.
- In the project explorer, click and drag the ‘Light.vi’ into the case structure.
- Wire up the SubVI as shown below.



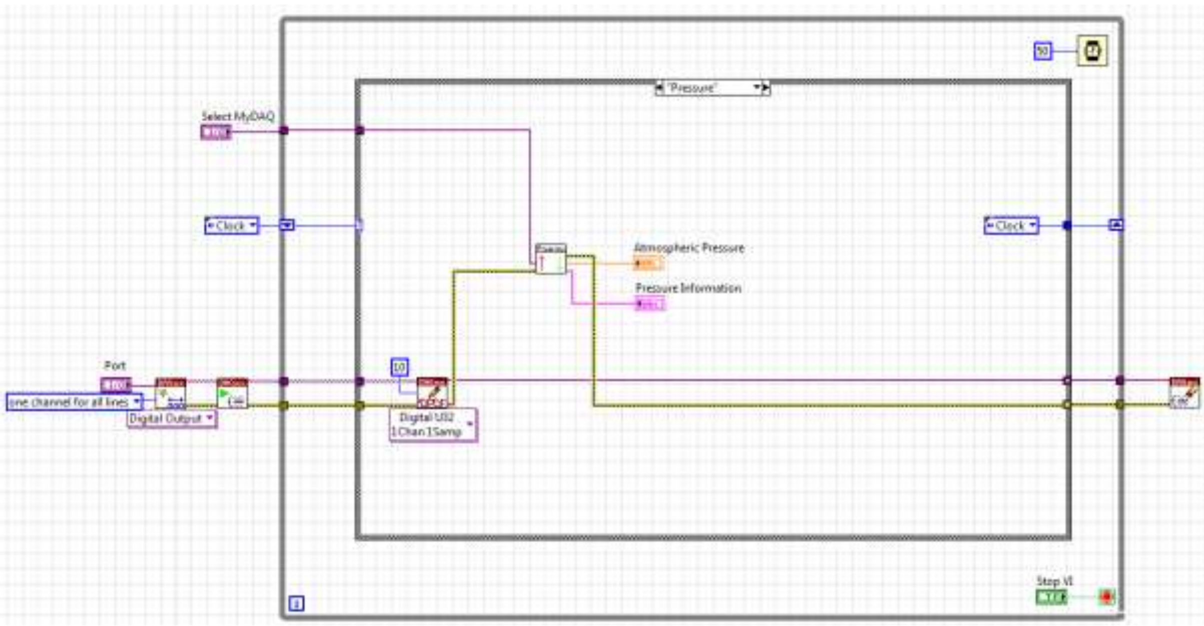
7. Let’s do the same for the ‘Temperature’ State.

- Navigate to the ‘Temperature’ State in the case structure; you should see the ‘Thermometer (°C)’ and ‘Temperature Information’ indicators.
- In the project explorer, click and drag the ‘Calculate Temperature and Levels.vi’ into the case structure.
- Wire up the SubVI as shown below

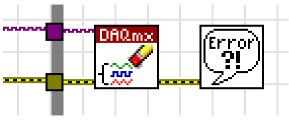


8. Again, lets wire up the ‘Pressure’ State

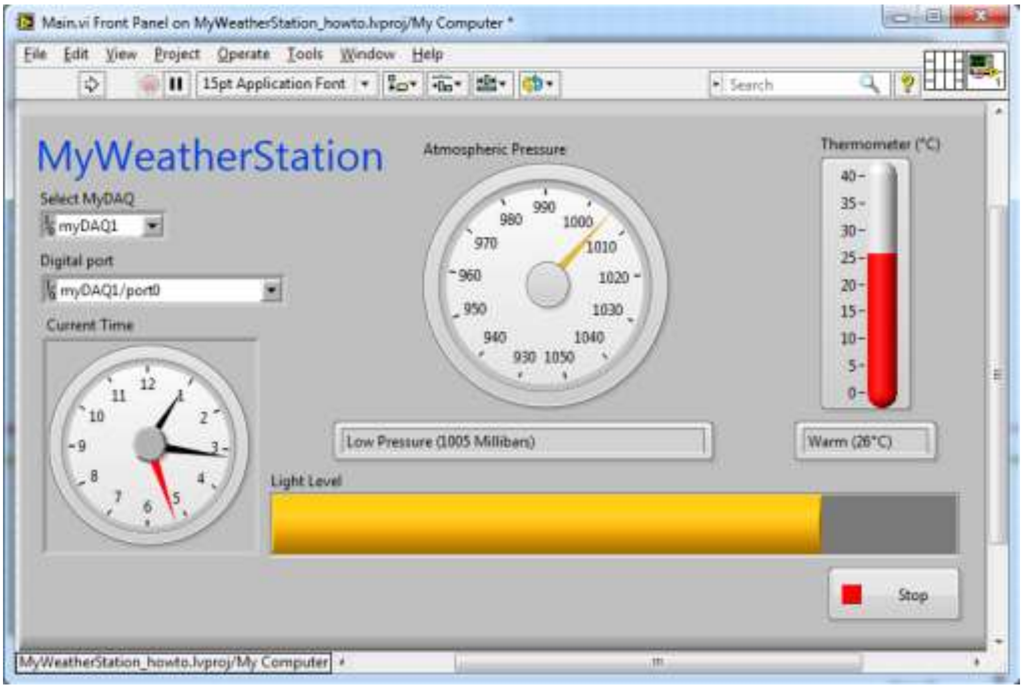
- Navigate to the ‘Pressure’ State in the case structure; you should see the ‘’ and ‘Temperature Information’ indicators.
- In the project explorer, click and drag the ‘Calculate Temperature and Levels.vi’ into the case structure.
- Wire up the SubVI as shown below



9. Add a ‘Simple Error Handler.vi’ after the ‘DAQmx Clear Task.vi’. Wire it as below.



10. Arrange your front panel as in the picture below.



11. The VI is now ready to be run, before running the VI ensure that the myDAQ is plugged in and the correct myDAQ is selected in the ‘Select MyDAQ’ and ‘Digital Port’ as ‘port0’.

If you do not see any measurements check the circuit diagram, ensure the myDAQ is plugged in and working through test panels, and then check your VI.

Appendix A – Electronic components

Quantity	Component	Model Number
1	Absolute Pressure Sensor	BMP-180
1	Temperature sensor	TMP-36GZ
1	Light Dependant Resistor	VT90N2
1	Analog Multiplexer	CD74HCT4051E
1	5 Volt Linear Regulator	U87805CKCS
1	10K Ohm resistor	N/A
1	330nf capacitor	N/A
1	100nf capacitor	N/A