Lab 04 – Tilt Detection using Accelerometer Tutorial

Step 1: Start LabVIEW(LV) Robotics 2009, and then create a new robotics project. The project explorer window will then pop up. Save this project as Lab4Accelerometer. Once the project has been created it will automatically build and open the Roaming VI from lab 1. Minimize this for now; however, we will be copying elements of this code later.

Step 2: Next we need to modify the FPGA file. From the project explorer expand *Starter Kit sbRIO*, and then expand *FPGA Target*. From the FPGA Target list, open the file *Starter Kit FPGA VI.vi*.

Step 3: This will be a FPGA VI where we will set up the new sensor required for this project. Reference the sbRIO quick start guide for pin information. If you do not have this pdf already, it can be found by going on ni.com and entering "9631" in the search bar, the first item on the list will be the sbRIO webpage for the robot. By going to resources, clicking on manuals, and then selecting user manual, you will be able to bring up the pdf file that contains the pin layout for the sbRIO. Depending on which pins you connect the sensor to will change what ports you will select for your FPGA VI.

Step 4: Open the block diagram for this vi and then add one while loop to the vi. Inside this while loop you will right click the stop sign in the corner and create a constant to have an infinite loop. This means the board will always be checking for information from the pins we will reference.

Step 5: Next, drag the ports that you will be using into the while loops. For the purpose of this tutorial, we will use ports AI0 and AI1. Afterwards, right click on the second output of each port (not the FPGA I/O output), select create, and then select indicator. Next, label the indicators x-axis and y-axis, pins AI0 and AI1 respectively. Once you have completed this step, the block you have added to your FPGA will look like figure 4.1. (*This is the same process as used in the Lab 3 tutorial.)*

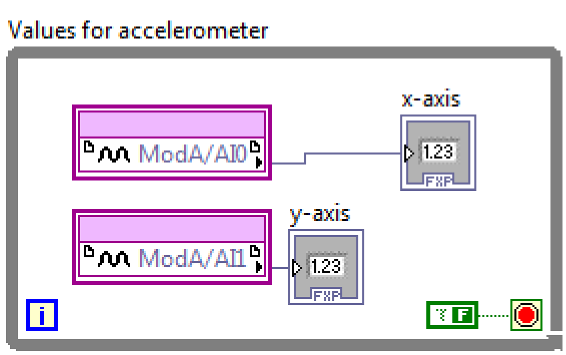

Figure 4.1

Step 6: Now that we have referenced the pins we will be using for this lab, we can begin to build our VI. Right click on *FPGA Target* in the project explorer window, and create a new VI; name this VI Accelerometer. In the block diagram of the VI, create a while loop. Next, open the roaming VI that we minimized earlier and copy the following code elements: sbRIO FPGA reference (1), Read/Write (stop motors)(2) Read/Write(Motor Control)(3), Close FPGA reference(4).

Figure 4.2

Step 7: Now add a read/write statement in the while loop and connect it to the sbRIO FPGA reference. Right click on the read/write statement and add another element. Left click on the first element and choose the X-Axis option. This is the pins that you created in the FPGA file earlier. Repeat this process for the second element and choose Y-Axis. Add indicators to both of the axis elements.

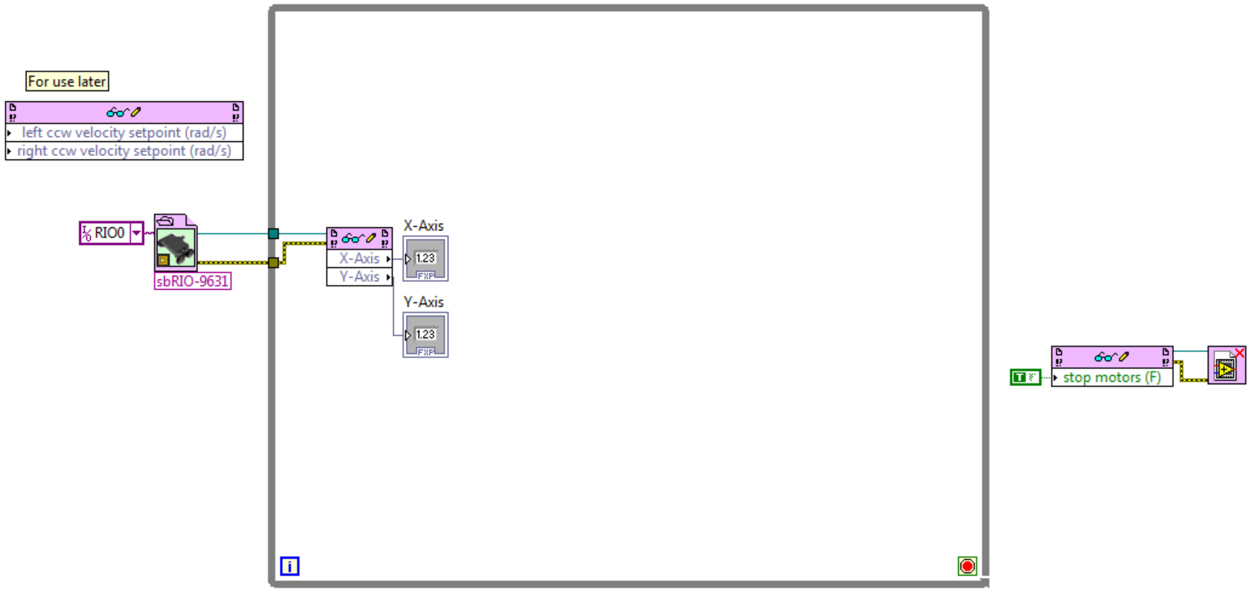

Figure 4.3

Step 8: The indicators that were set up in step 7 will read an analog voltage from the sensor. If the sensor is at rest and laying on a flat surface, the voltage should read 2.5 volts. It will read 2.5 volts, because that is half of the voltage we are using. To convert this voltage to acceleration, the following equation must be used.

$$Acceleration = \left(\frac{Analog\ Voltage\ Value - \frac{1}{2}Vcc}{0.312} \right) * 9.8$$

When coding this equation in LabVIEW, it will look like figure 4.4.

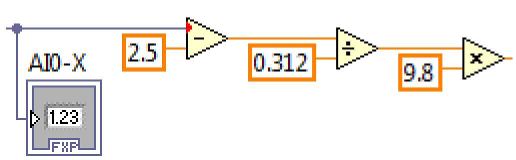

Figure 4.4

Create the code for the X and Y axis, and then add indicators at the end of the equations. This will allow the acceleration to be viewed for testing purposes. When you are finished your code should look like figure 4.5.

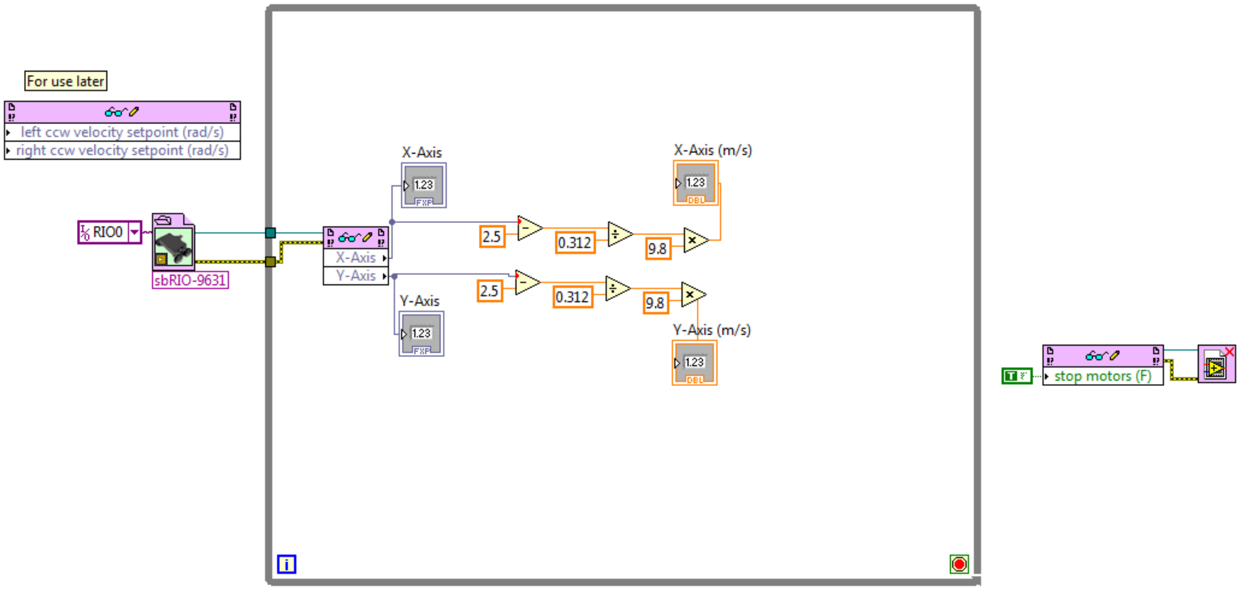

Figure 4.5

Step 9: Now three conditions must be created based on the readings from the sensors. Only one axis will be used, and the axis will depend on the orientation of the sensore mounted on the robot. For the purposes of this tutorial, we will use the X-Axis. The three conditions are: Acceleration < -0.23, -0.23 < Acceleration < 2, and Acceleration > 2. When coding this in LabVIEW, it will be similar to figure 4.6.

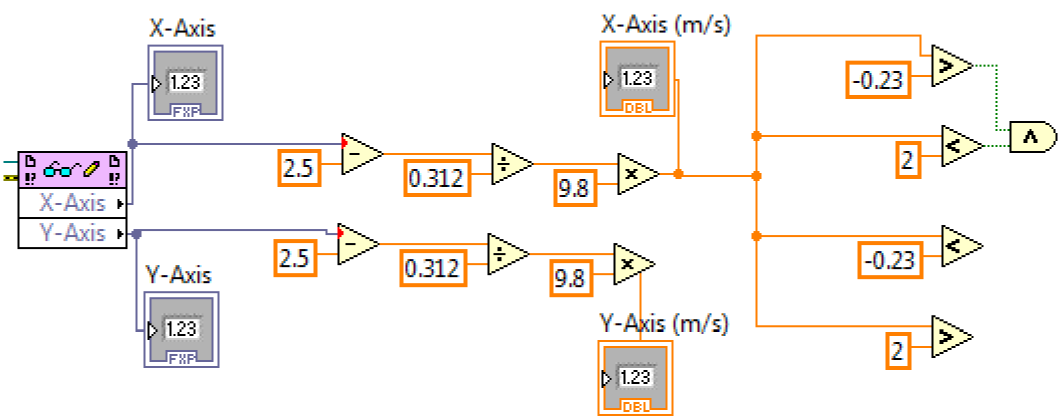

Figure 4.6

Step 10: Now Three Cases must be set up for the three different sensor scenarios. If the sensor is reading between -0.23 and 2, this means that the robot is level. If the robot is level then the code from figure 4.7 should run. Otherwise the robot will be tilted (In the case of this lab it will be half off of the ramp). For this case either the code from figures 4.8 or 4.9 should run. The code in figure 4.7 will just cause the robot to continue moving forward. The code in figure 4.8 and 4.9 will cause the code to back up, turn 90 degrees in such a way that the robot is facing the inside of the ramp. Next the robot will move forward far enough that it is centered with the ramp, and then turn 90 degrees back toward the ramp. Finally the robot will restart the loop and attempt to move forward up the ramp.

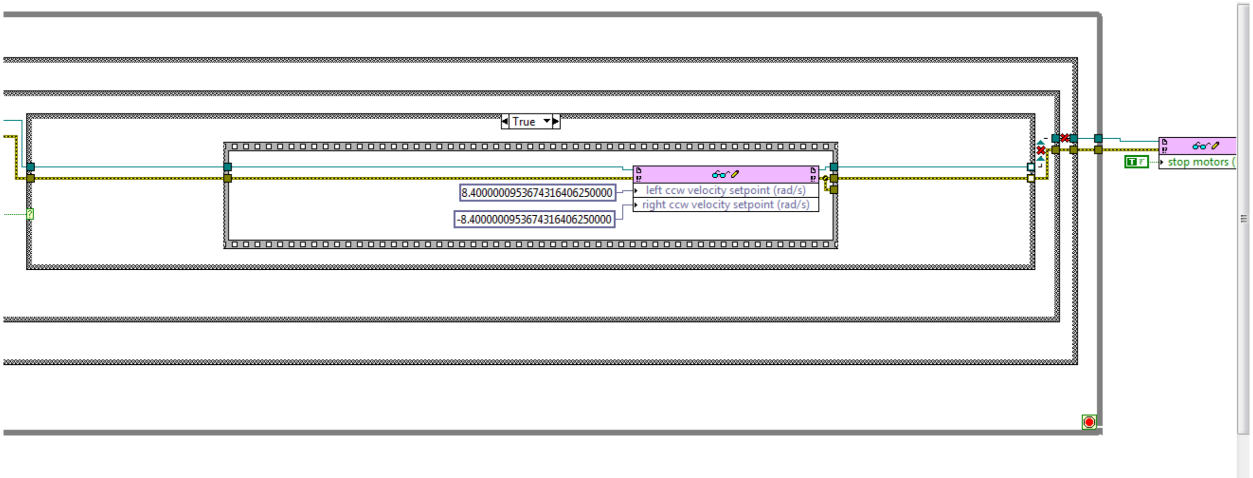

Figure 4.7

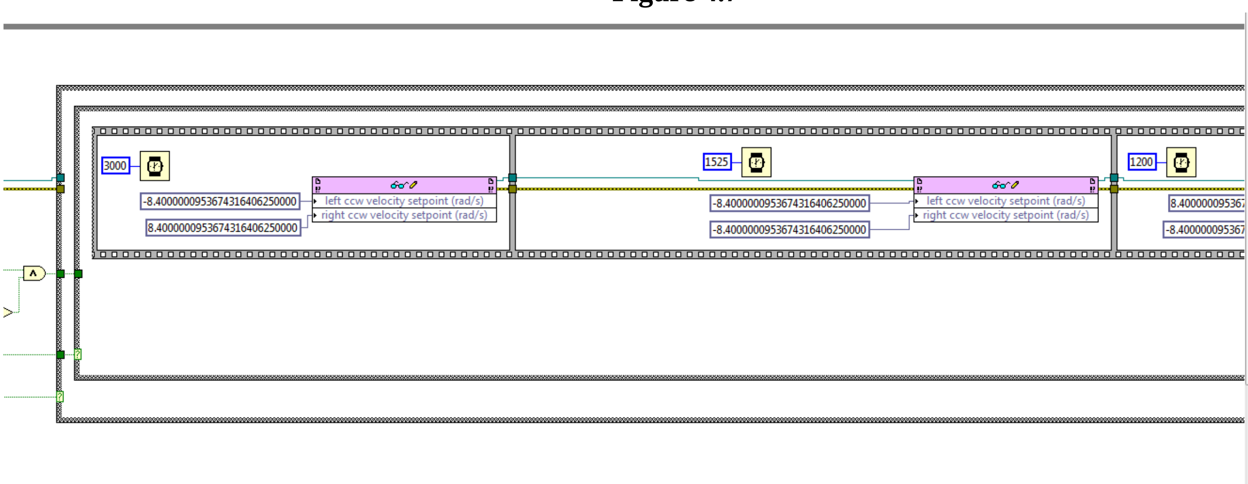

Figure 4.8a

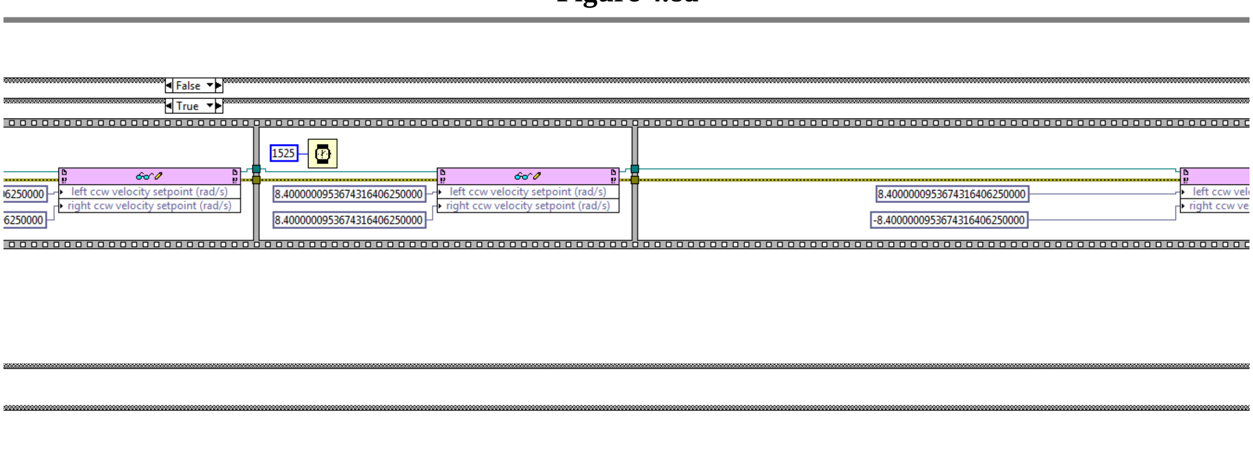

Figure 4.8b

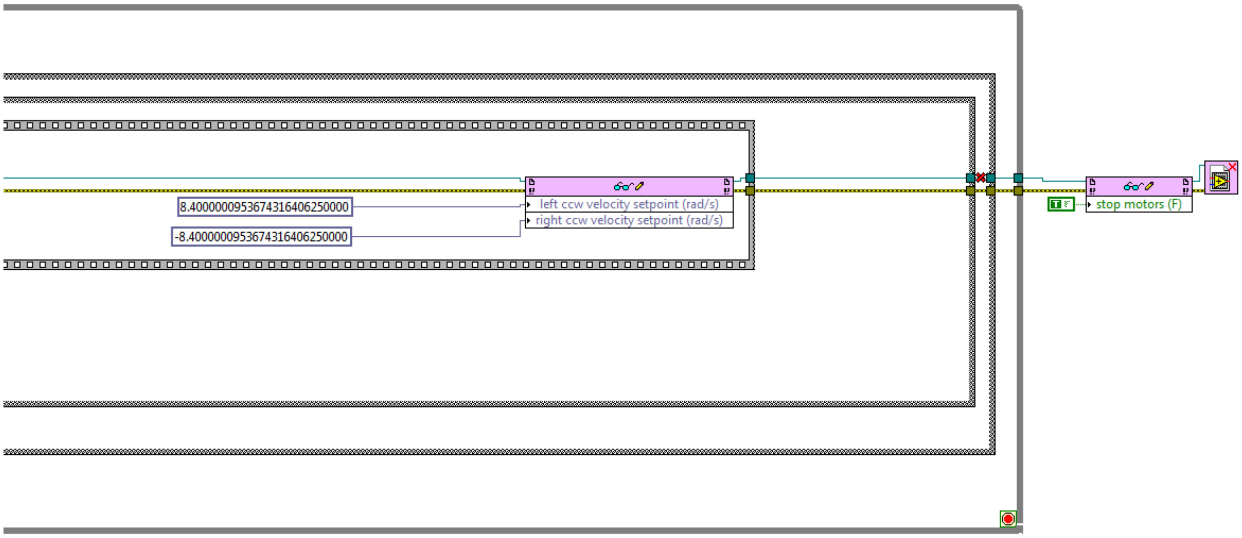

Figure 4.8c