CSCI130: Mobile Robotic Devices Embedded Systems
Lab 4: Analog Read

Lab Overview:

This lab is an exercise in which participants use the Romeo Microcontroller kit and the IO Trainer Kit to implement an embedded system that can read signals from analog devices.

Pre lab:

In this lab, participants will need the Serial Terminal application used in Lab 3.

Special note – There is a jumper near the push button switch on the Romeo board labeled A7/S1-S5. The jumper ties A7 to the switches. If A7 is required for other devices, the jumper must be removed.

Lab 4A 3 Marks

i. Connect the IO Trainer board's Vcc, GND and Pot pins to the Romeo board. The Pot pin can connect to any Analog Port.

ii. Write a C program read the analog value of the pot and display it on the serial terminal. The value must be displayed on the same line.

iii. Aside from the USART functions, the program must have 2 other functions, initADC and analog.

iv. The example functions In the lecture notes set the ADC for 10-bit resolution. Modify the functions to output 8-bit resolution.

v. Name the file lab4a.c

Lab 4B 6 Marks

i. Connect all 8 ouputs of the Pololu Reflectance Sensor Array to the analog ports on the Romeo board. Remember to connect the Vcc and GND and remember the special note about A7.

ii. Rewrite the initADC and analog functions to output 10-bit resolution.

iii. Using the program written in 4A(with the rewritten 10-bit functions), test the values of the sensors by placing a finger over one of the sensors in the array. Note how the value changes as the finger moves closer/further away from a sensor.

iv. Write a C program that displays a number that represents the position of one's finger on the array. The number should be a continuous number between 1000 and 8000. For example, if one finger is placed squarely on Sensor 4, the position is 4000. As the finger shift to Sensor 5, the number should linearly increase to 5000.

Hint 1: Participant can write the program using any algorithm but the following formula might be useful.

$$position = \frac{1000 \cdot Val0 + 2000 \cdot Val1 + \cdots + 8000 \cdot Val8}{Val0 + Val1 + \cdots + Val8}$$

Hint 2: Remember to take into account (4B iii)

v. Name the file lab4b.c

Lab 4C 6 Marks

i. Connect the Sharp GP2Y0A41SK0F IR distance sensor to the Romeo board

ii. The Sharp sensor is a sensor that detects an object and returns a voltage that represents the distance to that object. The detection range of this sensor is between 4cm and 30cm. Figure 6-1 located on page 8 of the sensor's datasheet shows a graph of the output voltage vs. the distance to reflective object. Write a C program that read in the analog value and displace the distance value in cm. Note that the graph is non-linear. It is best to create a lookup table.

iii. The signal from the sensor can be very noisy. Participant MUST use some sort of filtering method in code. The output of the program must be accurate within +/- 1cm.

iv. Name the file lab4c.c

Submission

Participant must submit a video demonstrating that the system works as described in 4A, 4B, and 4C. The video can be uploaded to the D2L or uploaded to Youtube (include link). Additionally, 3 files should be submitted through D2L: lab4a.c, lab4b.c, lab4c.c.