

CECS 347 Lab 4 -- Measurement of Distance

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Preparation

You will need a LaunchPad, an IR distance sensor, a ruler, and a Nokia 5110 LCD.

Book Reading Textbook Sections 8.5, 8.6, 9.6, 10.1, 10.4, and 10.5

Starter project Labware\Lab14_MeasurementOfDistance

Purpose

This lab has these major objectives: 1) an introduction to sampling analog signals using the ADC interface; 2) the development of an ADC device driver; 3) learning data conversion and calibration techniques; 4) the development of an interrupt-driven real-time sampling device driver.

System Requirements

In this lab you will design a distance meter. An IR distance sensor converts distance into voltage. Your software will use the 12-bit ADC built into the microcontroller. The ADC will be sampled at 20 Hz using SysTick interrupts. You will write a C function that converts the ADC sample into distance, with units of 1 cm. That data stream will be passed from the ISR into the main program using a mailbox, and the main program will output the data on an LCD display.

Procedure

1. Connect one IR distance sensor to the corresponding ADC input and debug on Launchpad, observe the ADC value change as you move and obstacle in front of the sensor.
2. Use a ruler to measure the distance when you debug on Launchpad: collect data and fill in the following table:

Distance (in cm)	Sensor Output(v)	ADC Output Values	Estimated Sensor output(ADCvalue*0.8mv)
10			
15			
20			
25			
30			
35			
40			
45			
50			
55			
60			
65			
70			

3. Create an array for the table obtained in previous step. Use table look up to find out the distance for a given ADC value.
4. Calibrate ADC output values and convert them to distance use a rational equation like $y=a/x+b$, where y is distance in centimeters and x is the digital voltage value obtained from ADC output, then solve two unknowns: a & b. Test and compare with the results obtained in step 2.
5. Add LCD code into your project and implement the display for distance information. The following information should be displayed on your LCD: ADC output value, distance obtained from table lookup, distance obtained from calibration.

Deliverable

- 1) Demonstrate your lab on board
- 2) Attached the following items to the end of this lab description and submit to Beachboard dropbox:
 - a. Lookup table obtained in step 2
 - b. The equation obtained in step 4 and test results. Use the following table to show your test results.

Distance (in cm)	Table Estimation	Equation Estimation
10		
15		
20		
25		
30		
35		
40		
45		
50		
55		
60		
65		
70		

- c. A short video or link to the video for your demonstration.
- d. Schematic and picture for your embedded system.
- e. Software source code.