

## **ECE 447 Lab Assignment #4: Capture and Compare with Timers and Interrupts**

Assigned week of 2/18/2015

### **Due Dates:**

1. Your code is due before **3:45pm** the day of your lab section in 1 week.
2. A hardware demonstration of the assignment is due during your lab section 1 week after it is assigned. Zip all your code and submit it on Blackboard.
3. The lab report is due on Blackboard by **3:45pm** on the same day as the hardware demonstration.

**Objectives:** Learn about using timers with interrupts and the capture and control modules on your MSP.

**Assignment:** In this lab you will use the timers, interrupts, and the capture and compare module(s) available on your MSP LaunchPad to interface with the **DHC22 Humidity Sensor** in your lab kit.

You will read the humidity from the DHC22 every 2 seconds and display the reading as a two-digit percentage value (00 to 99) on your two seven-segment displays. This two second delay will be implemented using timers and interrupts, and the MSP must be in low-power mode while waiting. To initiate a reading of data from the DHC22 Humidity Sensor, you must hold the data line low for 18ms, then hold the data line high and wait for the sensor to respond. You will use timers and interrupts to send this start condition.

The sensor then sends back 40 pulses (low-high-low) to communicate its measurements. Each pulse represents one bit of data (MSB first), and the duration of these pulses (not the voltage level) indicates whether the pulse corresponds to a 0 or 1. You will use timer capture and compare register(s) to measure these pulse durations in order to interpret this data.

You will again include main code in main.c and generic input/output definitions in the supporting header file ports.h. Do not forget to include msp430.h in ports.h. You will use the same sseg.h and sseg.c as in the previous labs, containing supporting code for your seven segment display (functions such as displayBCD). You should place code specific to the DHT22 Humidity Sensor in a new pair of files dht.h/dht.c and call functions from these files in main.c.

**Hardware requirements:**

1. Connect your two seven-segment displays using 74HC flip flops as in previous labs.
2. Connect the DHC22 Humidity Sensor to your MSP LaunchPad on a capture/compare input port.

**Software Requirements:**

1. Use port multiplexing to control the two seven segment displays with one data port and one clock port as in previous labs.
2. Read humidity data from the DHC22 using capture/compare modules and timers.
3. All delays must be implemented using timers and interrupts (**no software delays allowed**). The device must be in low power mode when waiting for a delay.

**Bonus:** Extra credit will be awarded for completing each of the following:

- Solder the hardware to a vector board.
- Display both the humidity and temperature on your seven-segment displays by alternating between the two measurements every second (remember a full reading is every two seconds).
- Use the checksum provided by the DHC22 to verify the correctness of each data transmission and indicate an error on your seven-segment displays if the checksum is invalid.
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