Requirements Specification for EE465 Lab Project 6:
Digital Temperature Sensor with I2C Serial Two-Wire Interface

++++++++++++++++++***UPDATED***++++++++++++++++++++++++++

Lab project goal:

Setup a simple menu system for the lab.

Display the 1 second on/ 1 second off heartbeat on the d7 bit of the 8 LED string. Keypads must be debounced. One push of a button yields one digit on the LCD.

Mode A: Read the temperature from an LM92 digital temperature sensor via I^2C communication and display the latest value on the LCD display. Also read the time from the DS1337 real-time clock and display the elapsed seconds on the LCD. Control the TE cooler with one of three possible single-digit commands entered from the keypad. Display the TE cooler status on the LCD.

Get the temperature value from the read-only temperature register of the LM92 and display the latest value on the bottom line of the LCD along with the elapsed time since that state was entered. A display format is specified in the following requirements. Display the LM92 temperature in **Kelvin** and time in sec.

Mode B: Enter a set point temperature T_{set} and control the TE cooler until the top aluminum block equals the set point temperature and then hold that temperature by heating and cooling the aluminum block as appropriate. Read the temperature from an LM92 digital temperature sensor via I^2C communication and display the latest value on the LCD display. Also read the time from the DS1337 real-time clock and display the elapsed seconds on the LCD. Get the temperature value from the read-only temperature register of the LM92 and display the latest value on the bottom line of the LCD along with the elapsed time since that state was entered. A display format is specified in the following requirements. Display the LM92 temperature in **Celsius** and time in sec.

Requirements for lab project completion:

1. Modify your HCS908QG8 circuit to match the schematic titled "EE465 Project 6". Note the change of RS and R/W_bar lines on the schematic. Each lab team member must build a hardware circuit and receive a sign off for his or her own circuit.

2. Main Menu:
On Power up the top line of the LCD should read: "**Mode: A, B?**" Enter Mode as one digit A or B followed by a "#" to indicate the end of the entry. If the entry is not A or B, ignore it and wait for a correct entry. (You may display an error message for a few seconds before returning to the main menu if you are so inclined.) Return to this main menu after a "*" is entered from the keypad.

3. Mode A

When **Mode A** is selected the top line of the LCD display should read:
"**TEC state:<**sp><sp><sp><sp><sp><sp>" where <sp> indicates a space.
The bottom line of the LCD should read:
"**T92:<**sp><sp><sp>**K@T=**<sp><sp><sp>**s**"

Read the temperature of the aluminum block above the TE cooler from the LM92 every **2 seconds**. Display the last read values in decimal format to the nearest degree in the appropriate spaces after "T92:", also update the elapsed time counter since the heating or cooling state was entered by reading the time from the DS1337 and display the seconds value read in the appropriate space after "@T=".

Connect the TE cooler relay control lines as shown on the schematic. Keep the LED's connected to the relay control lines as shown to provide an indication of TEC state.

If a "**0**" is entered from the keypad, switch the relays so no current flows to the TE cooler and display "off" in the space after "TEC state" on the top line of the LCD. On the bottom line display current temp without incrementing time.

If a "**1**" is entered from the keypad, switch the control relays so current flows to the TE cooler with the polarity selected such that the aluminum block above the TEC heats. Display "heat" in the space after "TEC state" on the top line of the LCD.

If a "**2**" is entered from the keypad, switch the control relays so current flows to the TE cooler with the polarity selected such that the aluminum block above the TEC cools. Display "cool" in the space after "TEC state" on the top line of the LCD.

4. **Mode B**

Function of Mode B - Hold a preset temperature using simple on/off control
Switch the polarity of the supply (using your heat and cool control lines) to the TEC so that the TEC heats or cools to a temperature T_{set} and holds that temperature. Displays and entries for this control strategy are:

When **Mode B** is selected the top line of the LCD display should read:
top line: "**Target Temp?**"
bottom line: "**Enter 10-40 C**" Enter T_{set} as two digits followed by a "#" to indicate the end of the entry. A "*" entry causes a return to the main menu at any time.

After entering T_{set} your control loop should begin to drive the actual temperature as measured from the LM92 to T_{set} and the LCD should read the following:

top line "**TEC state:HeatXX**" or "**TEC state:CoolXX**" where XX is T_{set}(the target temperature for the aluminum block)

bottom line: "**T92:<**sp><sp><sp>**C@T=**<sp><sp><sp>**s**" The time either heating or cooling should be displayed in seconds.

Once T_{set} is reached display the following on the LCD and continue to either heat or cool to hold the desired actual temperture.

Display "**TEC state:HoldXX**" where XX is T_{set}(the target temperature for the aluminum block) on the top line when the target temperature, XX, is attained.
bottom line: "**T92:<**sp><sp><sp>**C@T=**<sp><sp><sp>**s**" The time holding should be displayed in seconds.

Return to the main menu after a "*" is entered from the keypad.

5 . Your project grade will be based on the report that you hand in during this or subsequent lab sessions. Your report must include:

a. A cover memo summarizing the methods you used to solve the problem. Follow the informative memo guidelines on the ECE web site. Your memo should include a summary that states:

1. amount of memory, RAM and FLASH, used by your program;
2. Interrupts used and interrupt vector assignments.

b. A listing of your file containing a header section with a clear description of the program purpose, key variables, and other information that would be useful to another programmer reading your listing at a later date. Your header should also include your name and your partners name, the date, and your EE465 lab session.

c. A flow chart for this program.

d. A sign-off from the instructor or a TA indicating that your program performed as required and the required circuit modifications were completed. **Each lab team member must build a hardware circuit and receive a sign off for their own circuit**. Please attach this requirements specification with signoff and partner names together with your listing and flowchart.

Lab Demo Due Thursday, April 24, 2014; Memo Report Due Tuesday, April 25, 2014.

Completed Lab Signoff

Name(s) Instructor/TA Date

April 8, 2014