Requirements Specification for EE465 Lab Project 6&7 Combined

Control of Thermoelectric (TE) Module using a Digital Temperature Sensor and Real Time Clock with I2C Serial Two-Wire Interface

Lab project goal: Read the temperature from an LM92 digital temperature sensor via I2C 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.

Control the TE cooler with three commands: 0 for off, 1 for heat, 2 for cool. Display the last command for the TE cooler on the top line of the LCD display.

For this lab we will be using the LED bar graph to indicate heat, cool and off. We will not actually wire in the TE Test Fixture.

Requirements for lab project completion:

1. Use Eagle Schematic Software to generate a schematic of your circuit using I2C to communicate between the three MSP430s that interface to the LCD, Keypad and LEDs along with the DS1337 Real Time Clock and the LM92 Temperature Sensor. You will need to add the LM92 Temperature Sensor, DS1337 and maybe some resistors.

2. 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"

3. Read the temperature of the aluminum block above the TE cooler from the LM92 every **2 seconds**. We will simulate this with your LM92 included in your kit. 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=".

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

5. This section will be demonstrated using the led bar graph. If the TE test fixture were used the aluminum block on top would change temperature and you could feel this change while measuring the temperature with the LM92.

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.

6. Your project grade will be based on the memo report that you hand in during this or subsequent lab sessions and your demonstration of your code written for this lab.

Your **Memo Report** must include:

a. A memo report summarizing the methods you used to solve the problem. Your memo report should include a flow chart for your program. See the "Example Lab Report" folder for an example.

b. Each student should upload their commented code to the appropriate "Dropbox" for this lab on D2L.

c. Upload a copy of your Eagle Schematic for Lab 6 & 7 Combined to the "Dropbox" for this lab on D2L.

Memo Report Date: Monday, May 4, 2020 (by 10 AM)

Code Demonstration:

c. 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 and demo a hardware circuit to receive a sign off for their own circuit**. A sign-off sheet will be kept by the instructor and TA indicating completion of the lab.

A video can be uploaded to D2L showing the demonstatrion.

Demo Due Date: Monday, May 4, 2030 (by 10 AM)