**ECE2049 A-2021 Lab 3**

**Sign-off Sheet**

***Bonus Sign-off***: **Friday 09/30/2022 *Report due***: **Tuesday 10/05/2022**

**Student 1:** Cristobal Rincon Rogers

**Student 2:** Lili Loughlin

**Board #**: 72

| PRE-LAB (students graded individually) | 5 | Student 1:    Student 2: |
| --- | --- | --- |
| Timer A2 measuring seconds | 5 |  |
| ADC12 making single channel, single measurements for ADC12\_A temp sensor once per second | 10 |  |
| Implement Scroll Wheel | 10 |  |
| Proper conversion and display of date & time (month and day – FEB 2 and hr min sec = HH.MM.SS) | 10 |  |
| Proper conversion and display temperature in degrees C and F | 5 |  |
| Edit mode using the scroll wheel | 20 |  |
| ***Use ADC12\_A interrupts rather than busy bit polling to get results*** | ***5*** |  |
| ***BONUS: Indicating field being edited by underline, blink or color inversion or such*** | ***5*** |  |
| Answer to TA Questions at Sign-off | 5 | Student 1    Student 2 |
| Report (answering ***all*** questions from the requirements section) | 30 |  |
| ***Total points*** | 100 |  |

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# Introduction

In this laboratory, we use the MSP430 peripherals to measure and display both the date and temperature on the LCD. We have two objectives: Firstly, we need to display the month, day, hour, minute, and second of the date (UTC style) while also showing the temperature in both Celsius and Fahrenheit. Secondly, we need to implement the scroll wheel in order to edit the date as needed. The purpose of this lab is to gain experience with analog-to-digital converters, timers, decimal-to-ASCII conversion, and LCD text.

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# Questions / Discussions

1. Explain why it is important to pass a copy of the time into the function rather than just using the global variable.
   1. It is important to pass a copy of the time into the function rather than just using a global variable because you do not want to accidentally change the variable representing the true time. You only want to modify a copy of it to avoid changing the actual time.
2. What data type did you use to store your time count?
   1. To store our time count, we actually created a Date Object using a struct. Instead of incrementing timer counts, when an interrupt occurred the date.sec field was incremented. When the date.sec field was equal to 60, then the date.min was incremented and the date.sec was reset to zero. The cycle continued incrementing hours, days, and months.

| struct Date {  unsigned int month;  unsigned int day;  unsigned int hour;  unsigned int min;  unsigned int sec;  }; |
| --- |

Figure 1: The code defining the date object.

1. Justify your choices in your report. What will the resolution of your readings be in volts and in C ?
   1. For the temperature sensor, we used a 1.5 Vref, therefore our resolution in volts per degree C is
      1. ((CALADC12\_15V\_85 C - CALADC12\_15V\_30C) \* Vref ) / (2K \* (85-30))
2. You should use “circular indexing” (i.e., something like index = time count modulo 30) to index your array rather than shifting the arrays around. It’s much more efficient. Explain why.
   1. Instead of shifting the array, you override the oldest value in the array which is one of the first / earlier values within the array. Not only does that save time but it reduces the number of unnecessary operations.
3. How will you map the output of the scroll wheel to months, days, etc.? Explain in your report.
   1. To map the output of the scroll wheel, we simply divide by the following:
      1. Months: we divide the output of the scroll wheel by the number of months in a year (12).
      2. Days: we divide the output of the scroll wheel by the max number of days in a month (31).
      3. Hours: we divide the output of the scroll wheel by the number of hours in a day (24).
      4. Minutes: we divide the output of the scroll wheel by the number of minutes in an hour (60).
      5. Seconds: we simply divide the output of the scroll wheel by the number of seconds in a minute (60).

# Conclusion

In conclusion, we created our own digital date timer using the MSP430 board and its peripherals. The LCD display showed the month (ex. “JAN”), day, hour, minute, and second; it also displayed the current temperature using the board’s internal sensor in both celsius and fahrenheit. We implemented two modes for this lab: display mode and edit mode. While in the edit mode, moving the scroll wheel on the board changed every individual aspect of the full date depending on how many times S1 was pressed. For example, if S1 was pressed once, the user could change the month shown on the LCD. This lab familiarized us with the MSP430’s ADC, as well as timers and text display.