ECEN 3360
Digital Design Lab #5
Reading Commands from the LEUART
Spring 2019

Objective: This assignment will be focusing on reading command strings sent from the phone to the Pearl Gecko via the BLE module. These commands will be structured with a character to signify start of command and a character to signify end of command. Commands sent without the start or ending frame characters must be ignored

Note: This assignment will begin with the completed Lab 4b, UART/BLE Communications

Lab 5 Due: Friday, March 22nd, at 11:59pm

Lab 5 Instructions:

1. Make any changes required to Lab 4b, UART/BLE Communications, lab. Please work with the Instructing Team to get your code working to Lab 4b.

2. To better match the energy measurements from your project to the expect results, all projects must enable HFXO to wake up and run after coming out of sleep energy modes. The following line of code should be added in your cmu.c function after all the calls to initialize the HFXO oscillator.
    a. **CMU_HFXOAutostartEnable**(true, true, true);

3. LETIMER0 should be set to the following conditions at startup / reset.
    a. Si7021 temperature read period = 3.0 seconds
    b. No LED heart beat requirement

4. Initialize/program the Pearl Gecko LEUART to work down into EM2 energy mode
    a. Enable the LEUART for both transmit and receive
    b. Set the energy mode to the lowest energy level that will allow the LEUART to receive data
    c. You must not enable Loop Back

5. Configure your LEUART to receive specified frames
    a. Set the LEUART to begin accepting an incoming frame when the character ?, 0x3F, is received from the BLE module
        i. Use the LEUART STARTF function and interrupt
        ii. You can use this STARTF interrupt to enable the LEUART0 RXDATAV interrupt

iii. With the RXDATAV enabled, you can tell your system or scheduler it is time to receive and "assemble" your command
iv. If a second STARTF was received before a SIGF, it indicates that the first command was aborted and that you need to restart "assembling" the command with the new data arriving.

b. Set the LEUART to notify a completed frame when the character #, 0x23, is received from the BLE module
   i. Use the LEUART SIGF function and interrupt
   ii. You can use the SIGF function to disable the LEUART0 RXDATAV interrupt
   iii. You can use this interrupt to tell your system or scheduler it is time to decode an incoming message

c. Define the command as follows:
   i. First character after the start of frame, ?, signifies the command
   ii. Following characters up to the end of frame, #, provides additional information regarding the command

6. The code must handle gracefully a command that was send without the proper STARTF and SIGF characters. For example, if the string df# was sent, no change to your transmitted scale should result. Without resetting, if the proper command, ?dF#, was sent, then the temperature scale should change.
   a. You should implement the RX OverFlow, RXOF, to properly handle these situations as unwanted characters will occupy the RXDATA buffer and prevent the desired STARTF from being received.
      i. What command should you send to the LEAURT0 upon this RXOF interrupt with the above defined usage?

7. I recommend the following changes to your interrupt handler routines. With the latest functionality of enabling and disabling interrupts, you only want to execute the code for an interrupt if the interrupt was enabled.
   a. At the top of you interrupt handler, it was recommended to do the following:
      i. Int_flag = LEUART0->IF;
      ii. Int_flag would be used to determine what Interrupt has occurred and take the appropriate action
   b. The new recommendation is the following:
      i. Int_flag = LEUART0->IF & LEUART0->IEN;
      ii. Int_flag will now only indicate interrupts that were enabled to take the appropriate action

8. You must use the LEUART RXOF, receive overflow, interrupt to allow a new character to move from the receive shift register to the receive buffer
   a. This interrupt will occur if you receive a character before the start of a frame and you then receive a start frame

b. To enable the new character to move from the LEUART receive shift register to the LEUART receive buffer, you must clear the LEUART receive buffer using the proper command bit in the LEUART peripheral upon receiving a RXOF interrupt.
    i. Once you clear the receive buffer, the start frame which is in the receive shift register can move up to the receive buffer and compared to the start frame buffer to generate the start frame interrupt if there is a character match.

9. Define the following command:
    a. Command character D, 0x44, and d, 0x64, to specify what temperature scale to provide the temperature to the BLE module to be sent to your phone
    b. The character after the command character will specify the scale
        i. C, 0x43, or c, 0x63, will specify the temperature scale to be sent as Celsius
        ii. F, 0x46, or f, 0x66, will specify the temperature scale to be sent as Fahrenheit
        iii. Examples commands
            1. ?Dc#, ?dC#, ?DC#, or ?dc# specify Celsius scale
            2. ?Df#, ?dF#, ?DF#, or ?df# specify Fahrenheit scale
    c. This command should start sending the specified temperature scale after the next read of temperature from the Si7021

10. Develop a routine to convert the temperature to the proper scale and append the correct temperature scale to the end of the temperature string
    a. Example:
        i. If Celsius, + 21.5C
        ii. If Fahrenheit, +70.7F

11. The LEUART should remain at the lowest energy mode during the reception and transmission of LEUART data from the BLE module
    a. Between bytes, the Pearl Gecko should be going to sleep

12. The Pearl Gecko should be able to receive and transmit data from the BLE module simultaneously

Deliverables:

1. Project code exported to Canvas for grading
2. Energy Profiler screen shot of receiving a command from the BLE module for grading
3. Lab 5 worksheet to be completed in Canvas

4. Deductions:
    a. Magic numbers - 3 pts
    b. Not unique files per peripheral - 3 pts
    c. No acknowledgement of IP - 2 pts

5. Late Submission:
    a. Due date to Sunday the 24th at 11:59pm - 5 pts
    b. Monday the 25th thru Tuesday, April 2nd, at 11:59pm - 10 pts
    c. After April 2nd - 15 pts
6. If code does not work, corresponding Quiz questions will be marked as 0 if answered correctly.