

# ECEN 5823

## HTP and OTA Assignment

### Spring 2018

**Objective:** To take the temperature measured by the Si7021 and communicate it via BLE to the Silicon Labs' Blue Gecko iPhone or Android phone app. The assignment also includes learning the steps to perform a secure Over The Air, OTA, firmware update

**Note:** This assignment will begin with the completed I2C temp sensor load power management assignment.

**Due (submission):** Wednesday, February 21st, 2018 at 11:59pm

**Due (demo):** Saturday 24<sup>th</sup>, 2018 at 11:59pm

Instructions:

1. Make any changes required to the I2C temp sensor load power management assignment.
2. LETIMER0 should be set to the following conditions at startup / reset.
  - a. Period = 4.0 seconds
  - b. No period, so no need to have the LETIMER0 to interrupt twice per period for LED heart beat
  - c. During the LETIMER0 period interrupt, it will request, receive, and process the temperature reading from the Si7021
3. Si7021 I2C temp sensor
  - a. It should be running at the lowest energy possible while enabled and while taking temperature measurements
  - b. Temperature measurements should be 14-bit and calculated in degrees C
  - c. There should be a define statement that sets the default temperature in degrees C to indicate whether the temperature is too low
    - i. The default temperature should be 15C
  - d. If the temperature read from the Si7021 is below the set temperature, LED1 is latched on until cleared by sensing the temperature above the set temperature point
4. The Blue Gecko should be running at the lowest possible energy state at all times
5. LED0 is not used in this assignment

6. Through the Launcher perspective in Simplicity studio, open the BLE SoC empty project example
7. From this BLE SoC empty project, copy the necessary lines of code in the while (1) loop to enable the Bluetooth radio to schedule the Bluetooth events as well as the events that your interrupt handler will be generating for scheduling
8. You will now be allowing the Bluetooth Radio to manage when to go to sleep, so you will need to delete your call to sleep routine
9. You will need to remove your own implementation of sleep routine and use emlib sleep routines using the library supplied by Silicon Labs that interact with the Bluetooth Radio sleep routine
10. Download and install the Silicon Labs' Blue Gecko app to your iPhone or Android phone
11. Now you are ready to begin putting your first Bluetooth Service together
  - a. Add the Bluetooth Health Temperature Service to your application via the .isc file
  - b. Your application should update the temperature and Bluetooth Health Temperature Service when the LETIMER0 period has expired
  - c. Your system should advertise that it supports the HTP service
12. Now you will set up your second Bluetooth Service
  - a. Add the Bluetooth TX\_Power service to your application via the .isc file
  - b. The TX\_Power characteristic is automatically updated when you modify TX\_Power
13. To maximize energy savings, the Bluetooth application should change its advertising, connection interval, and slave interval to what is appropriate to the application.
  - a. Set the Advertising min and max to 337mS
  - b. Set Connection Interval minimum and maximum to 75mS
  - c. Set the Slave latency to enable it to be off the "air" up to 450mS
14. To further maximize energy savings, the application should automatically adjust its transmit power based on the proximity of the master / client, the phone. Please use the following settings:
  - a. If rssi > -35db, set tx\_power to BGM121 TX Min
  - b. If -35db > rssi > -45db, set tx\_power to -20db
  - c. If -45db > rssi > -55db, set tx\_power to -15db
  - d. If -55db > rssi > -65 db, set tx\_power to -5db
  - e. If -65db > rssi > -75db, set tx\_power to 0db
  - f. If -75db > rssi > -85db, set tx\_power to 5db
  - g. If rssi < -85db, set tx\_power to BGM121 TX Max
  - h. Upon reset or a Bluetooth connection disconnect, TX Power should be set to 0db

15. Over the Air Update should be implemented

- a. To demonstrate the OTA update, you will update your firmware via OTA with a new temperature set point of 40C. This will trigger the LED1 low temperature warning LED to be turned on.

Questions:

In a separate document to be placed in the drop box with the program code, please answer the following questions:

**NOTE: All average currents should be taken at a time scale of 250uS/div.**

1. Provide screen shot verifying the Advertising period
2. Provide screen shot verifying the connection interval setting
3. Provide screen shot verify slave latency
4. What is the average current between advertisements?
5. What is the average current between connection intervals?
6. What is the peak current of an advertisement?
7. What is the peak current of a data transmission when the phone is placed next to the Blue Gecko?
8. What is the peak current of a data transmission when the phone is placed 20 feet away from the Blue Gecko?

Deliverables:

1. One document that provides the answers to HTP and OTA Assignment.
2. The completed program project or required files to enable the code to be ran on the instructing team's computer for grading.
3. Arrange a demonstration of the OTA update and auto TX power setting with the TA team

