Lab 10

Submission: 28th January, 2020

[Adding Bluetooth (BT) with TM4C123]

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In this lab, you need to add Bluetooth (BT) with TM4C123 MC. You need to install an app in your phone/laptop. With that app you can send data/request to TM4C123 without wired connection. However, you still have a connection with your laptop and TM4C123 as laptop is the source of power for TM4C123. Unfortunately, there is no app for iOS devices that can be used as a terminal for Bluetooth device as apple doesn’t support accessing devices with serial terminal. The name of the app that you can use with android device is “Serial Bluetooth Terminal”. Also, for windows laptop you can use a software “Bluetooth Serial Terminal”.

You can find a very detailed information to implement Bluetooth (ZS-040) with TM4C123 MC in the link ( <https://microcontrollerslab.com/hc-05-bluetooth-interfacing-tm4c123g-tiva-launchpad-keil-uvision/> ). ZS-040 is from same family HC-05. So, the PIN orientation, initialization and connection of ZS-040 is very similar to HC-05.

Bluetooth device ZS-040 uses UART communication protocol to connect with TM4C123. Therefore, at first you need to select an UART module (Tx and Rx pins). You also need to connect 3.3v and gnd. When you connect and initialize the ZS-040 with TM4C123, you will see HC-05 at your Bluetooth preference tab in your laptop/phone. You need to use passcode “1234” (90% of times) or “0000” (rest) to connect the BT with your phone/laptop. Then you can open the app and (reconnect BT in the app) access TM4C123 from your laptop.

However, it is sometimes confusing to check if BT is performing properly or not. For testing purposes, you can use 3.3v FTDI cable to connect the MC with laptop. You can send request from laptop and see if it is executed in TM4C123. In that case collect the FTDI cable from lab (we have very few of them I guess). Here is the link to use UART wired connection as an example (<https://microcontrollerslab.com/uart-communication-tm4c123-tiva-c-launchpad/>).

Lab 10(a): Use UART5 module of TM4C123 to connect the Bluetooth with MC. The given BT is by default set as slave device. So, you need to assign work from app. You need to use TIMER0 to generate 1-sec delay. In Lab 10(a), you need to write a code that satisfy the following conditions:

(i) If you send ‘A’ from app to MC, the response should be RED LED blink twice at MC. Also, MC will reply back as “Hello World!! RED LED ON.”

(ii) Similarly, if you send ‘B’ from app to MC, the response should be BLUE LED blink twice at MC. Also, MC will reply back as “Hello World!! BLUE LED ON.”

(iii) Also, if you send ‘C’ from app to MC, the response should be R-B-G LED blink once each at MC. Also, MC will reply back as “BYE World!! RBG LEDS ON.”

(iv) For any other request, the MC should be silent.

Lab 10(b): This part is the extension of Lab 9. In lab 9 you have designed an ADC initiated interrupt thermometer. In this lab you have to extend that capability to see the temperature at your phone/laptop whenever you want (a periodic 10-sec delay is generated by TIMER1). Normal 1-sec or ms delay is generated by TIMER0. You can use ADC0 in channel 7 (or which one is good for you). In Lab 10(b) you should use UART5 to connect the BT with TM4C123. You need to satisfy the following conditions:

(i) If you send ‘A’ message from app to MC, the TM4C123 MC should response with the current measured temperature (as temperature is measured in every 10-sec). The response should be “Current Temperature is: “ and “ the value”. Next It should also print, “Temperature increase: ” “difference” or “Temperature decrease: ” “difference” or “Temperature unchanged”. This the temperature difference of last two measures. We can assume this property as apps/user initiated activity.

(ii) Second feature would be, if the difference between current and last temperature is 2-degrees less, RED LED will blink twice (assume heater will turn ON). Similarly, in opposite Green LED will blink twice (assume cooler will turn ON). As in background periodic ADC interrupt measures temperature all the time, TM4C123 would initiate this activity.

Comments:

You need to be very careful while calculating BAUD rate. You have seen in last few labs the TIMER generated delay didn’t match. In this lab, you need to use actual delay (not the bus/system frequency). It can be around 50 MHz. If difference of BAUD (bits/second) rate of TM4C123 and receiver (phone/laptop app terminal) is more than 2%, you will not see data/response in app terminal. The default BAUD rate of the terminal is generally 9600.

Keep the phone/laptop and Bluetooth device near. The ZS-040 requires operating voltage of 3.6 to 5 volts. However, we are applying 3.3v that makes the range very small.

Submission:

Please submit the screenshot and copy of your codes in one file. Also attach screenshot of transmitting and receiving message for all conditions with the file. Also add a video of all activities within 1-minute frame.