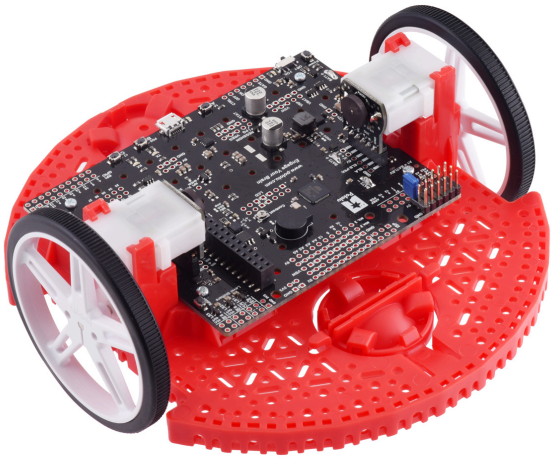
CECS 447 Fall 2023
Project 3: BlueTooth Controlled Car



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Control Romi Chassis via BlueTooth through UART

Introduction:

In this project, we will use serial port communication, UART, between the TM4C123 and a peripheral device connected via BlueTooth. Once the two devices are connected the TM4C123 will receive commands from the master device that will instruct it to move forward, backwards, left, right, stop, and speed up or slow down. Additionally, either implemented in the main project or in another project the user will be able to boot up the HC-05 BlueTooth module into a command mode where they will be able to modify the naming and connection attributes via TeraTerm.

Operation:

In order for the system to work, the .c and .h files would have to be downloaded. Once all the files are downloaded, run the files on Keil V5 with the board connected to both Romi for power and steering, and HC-05 BlueTooth module for instructions to be passed to TM4C123. For this demo, you will need:

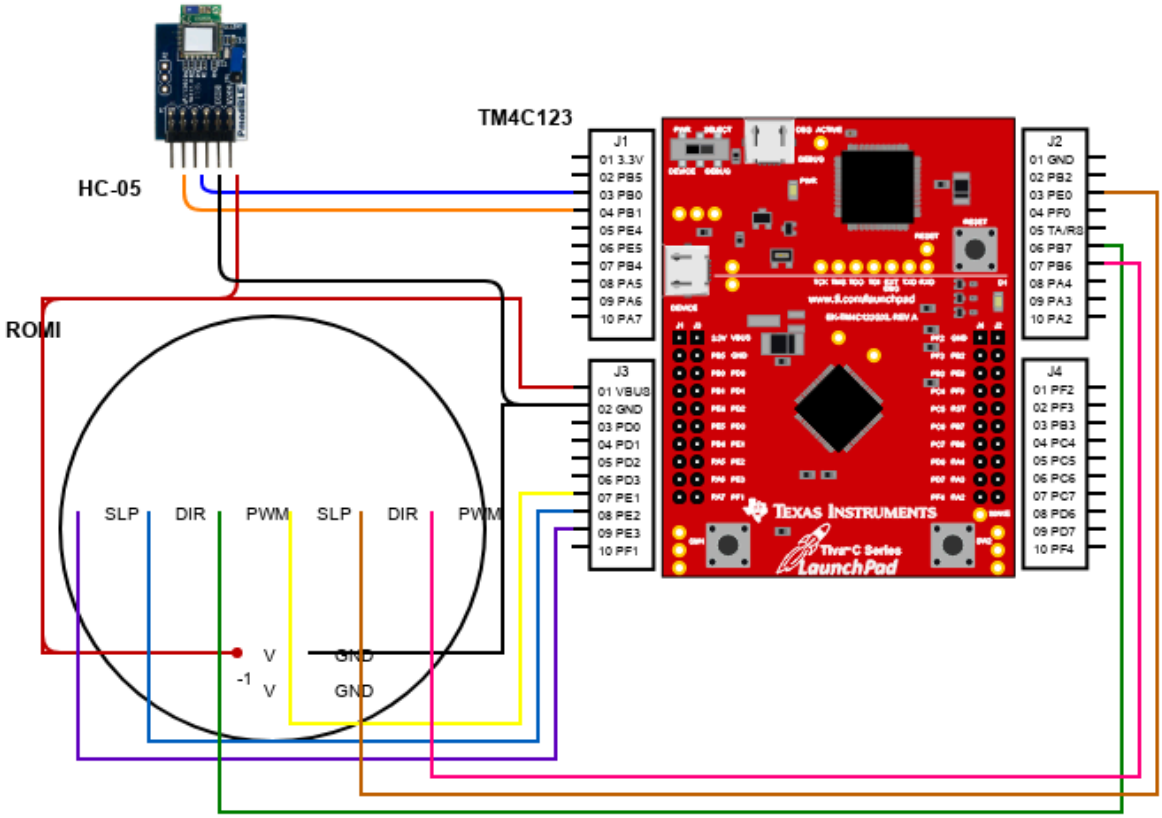
- LaunchPad
- Jumper wires
- Tera Term
- Romi Chassis
- HC-05
- 6AA Batteries

Lab Demo Link:
Demo

Theory:

This project leverages several aspects of microcontroller programming that we have been exposed to up till this point. The most recent of these being the principles of Bluetooth communication, including pairing, data transfer, and the AT command set, which is key to implementing this aspect of the project. For this aspect we also refer to our learnings by creating a user interface to control the different attributes of the HC-05 BlueTooth module. Furthermore, BlueTooth builds on our understanding of serial port communication as we are using UART to facilitate the communication between the primary, the phone or computer, and the secondary BlueTooth module, the HC-05. Specifically this is overseen by our Port B pins 0 and 1 making use of UART1 from the HC-05 which is then passed to UART0 on the TM4C123. Lastly we implement the use of pulse width modulation to control our motors to enable the functionality to maneuver the bot with sequential commands. By varying the power to our wheels we are able to speed up, slow down, and turn in both the left and right directions facilitating all the different use cases that the project calls out for.

Hardware Design:



Schematic of hardware design

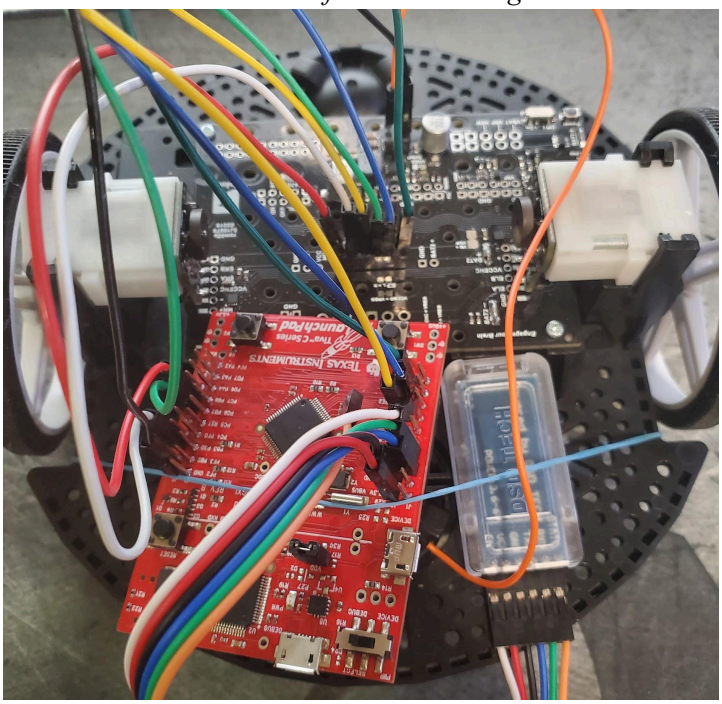
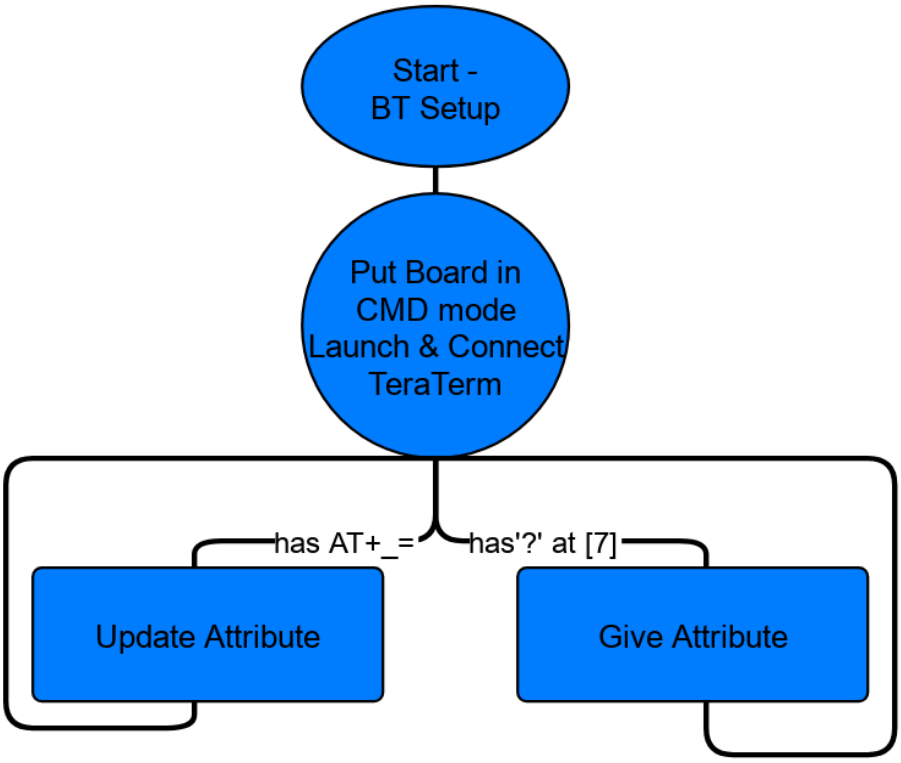


Photo of hardware

Software Design:

Once all of the ports and configurations have been managed the logic of the code is relatively simple. In the main superloop the HC-05 waits for a command to be received from the master BlueTooth device once received the piece of data is ultimately passed to a switch statement where the character is deciphered into a segment of code that changes the LED, enables or disables the motors, or potentially modifies the PWM which then impacts the speed of of the Romi chassis. Additionally, LED.c initiates PortF for the purpose of the LEDs, PWM.c facilitates the motor initiation, and UART.c which handles all communication that is transmitted and received from the TM4C123. For BlueTooth setup we have SetupBLT.c which interacts with the user to update and inquire about the HC-05's configuration while we have additional UART modules that facilitate the same communication seen in the executable program to wirelessly control the Romi chassis.



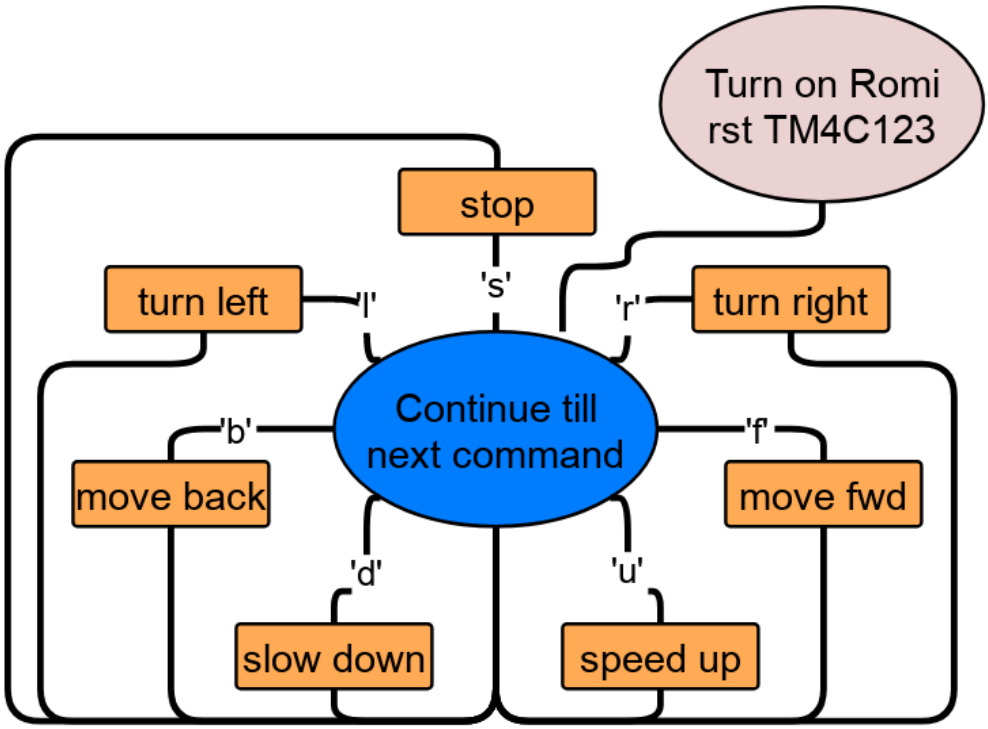


Diagram of design

Conclusion:

We were able to create a setup project that allows a user to define the attributes to the HC-05 BlueTooth module that other peripheral devices can use to connect to the module. A challenge we had in the project was remembering to connect/disconnect EN for flashing and bonding. Furthermore, using the BlueTooth Controlled LEDs and Romi Car Test sample projects we were able to implement a program that once flashed onto the TM4C123 would allow us to control the Romi Chassis' movement via simple commands issued via the BlueTooth connected device. This project gave us a solid foundation in learning how to interface with BlueTooth technologies which are only becoming more relevant as IoT continues to grow and implement them due to its versatility and low energy demands.