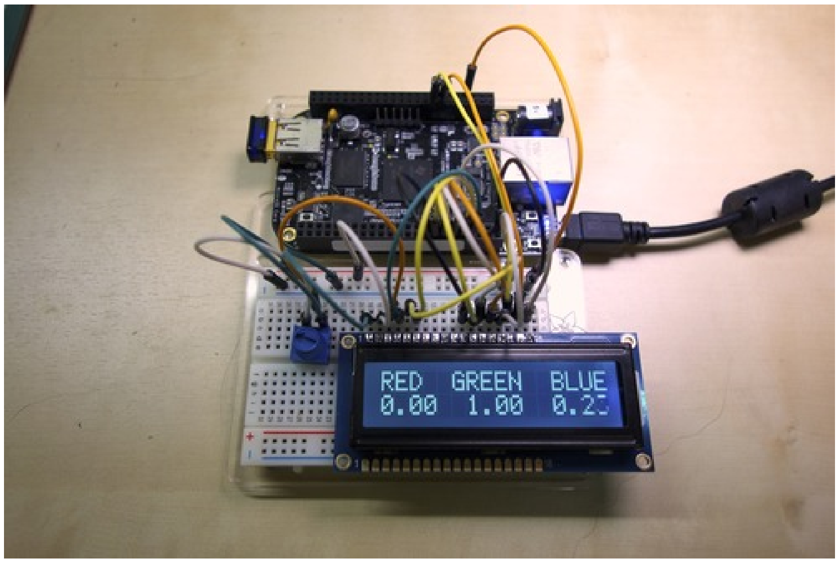
adafruit learning system

Character LCD with Raspberry Pi or BeagleBone Black

Created by Tony DiCola



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Guide Contents

Overview

Looking for a simple way to add a text display to your Raspberry Pi or BeagleBone Black project? Consider using a character LCD with the Python character LCD library (http://adafru.it/dJo)! These classic displays can show a few lines of text, are inexpensive, and easily readable during the day or night with a bright backlight. You can follow this guide to learn how to connect a character LCD to a Raspberry Pi or BeagleBone Black and control the display from your own Python code!

Before you get started it will help to familiarize yourself with the character LCD guide (http://adafru.it/dJp). You will also want to make sure your Raspberry Pi is running the latest Raspbian (http://adafru.it/dpb) operating system, and your BeagleBone Black is running the latest Debian (http://adafru.it/dvh) or Debian-based distribution like Ubuntu.

If you haven't used a Raspberry Pi or BeagleBone Black, be sure to follow the Learn Raspberry Pi series (http://adafru.it/dpe) or BeagleBone Black SSH guide (http://adafru.it/dEN) to understand the basic usage of each board and how to connect to a command terminal.

When you're ready to get started, grab a character LCD, contrast adjustment potentiometer (included with Adafruit character LCDs), and a Raspberry Pi or BeagleBone Black. Continue to the next page to learn how to wire the display to your board.

Wiring

Follow the steps below to wire a character LCD to your development board. Be careful to connect each wire to the correct pins as there are quite a few wires necessary to use the character LCD.

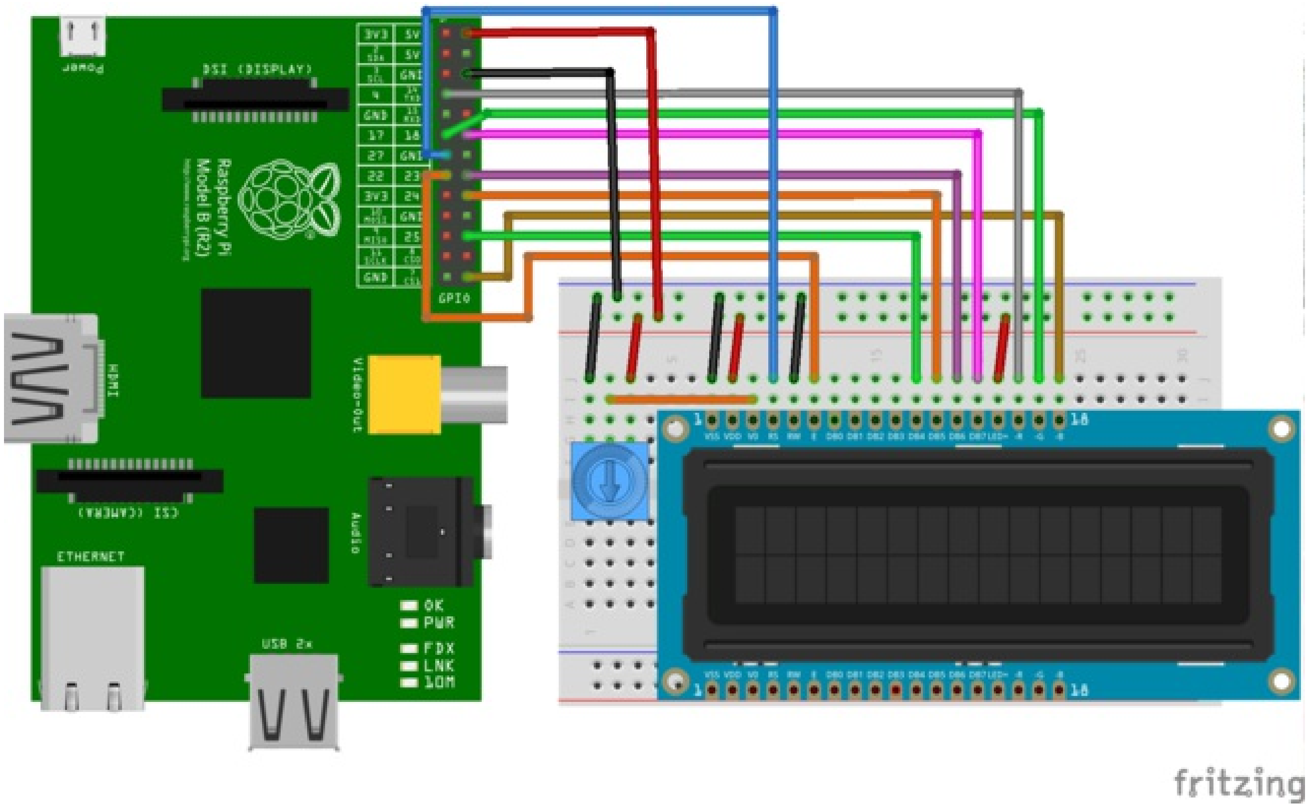
Note: The wiring below is for an RGB backlight display. If you're using a monochrome backlight display you can use the wiring as-is and ignore the green and blue backlight wires. The red backlight wire will be used to control the monochrome display's backlight.

If you would like to permanently turn on the LCD backlight, connect the red, green, blue backlight wires to ground instead of to your development board.

The wiring below assumes you're using an Adafruit character LCD which has integrated resistors for the backlight LEDs . If you're using another LCD be careful to check if it's necessary to add a resistor to the backlight power pin. If you're unsure, it can't hurt to replace the wire from LCD pin 15 to power with a 1 kilo-ohm resistor.

Raspberry Pi

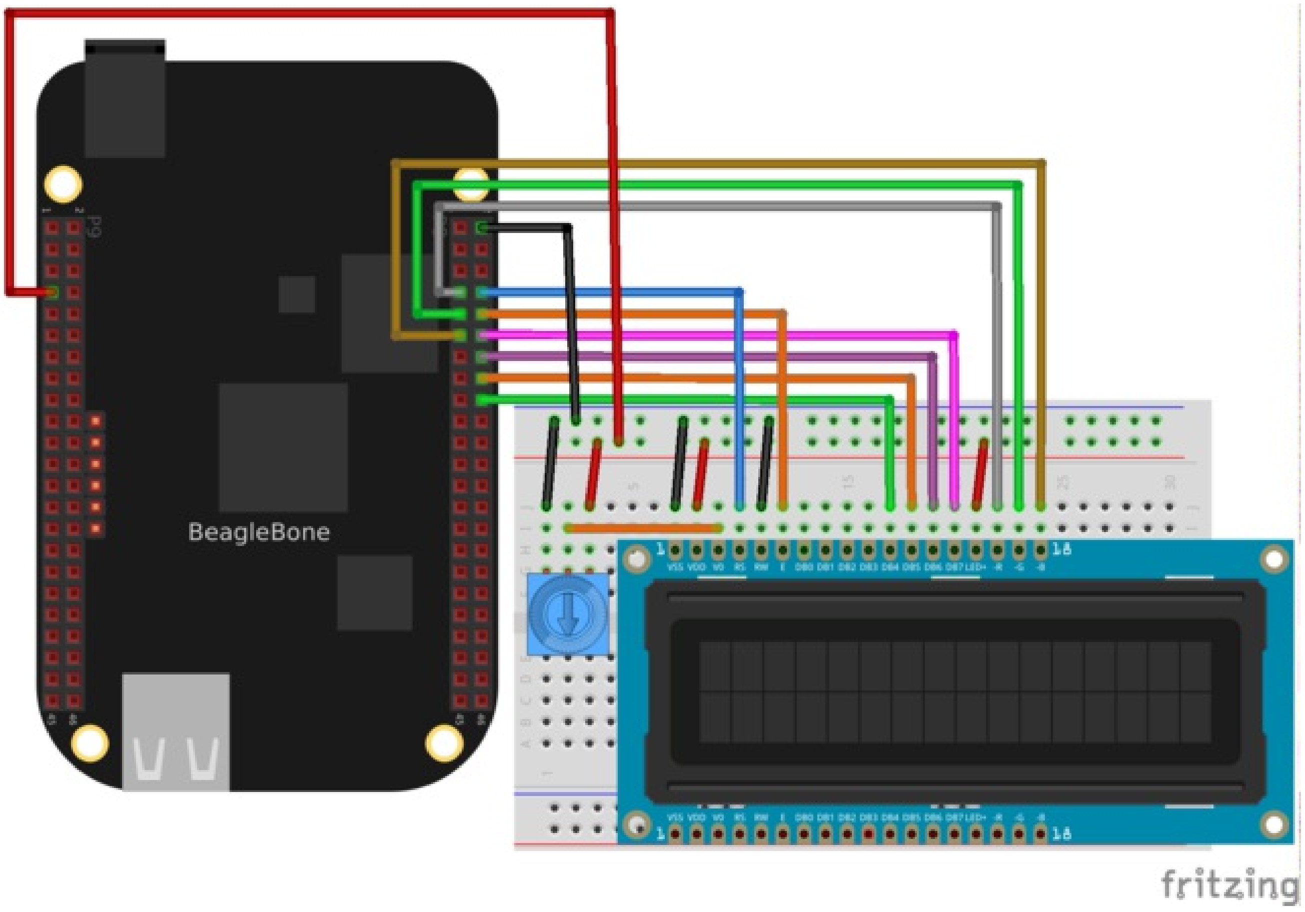
Wire your character LCD to the Raspberry Pi as follows:



- Connect **Pi 5V power** to the **power rail of the breadboard**. From the power rail connect **one outer lead of the potentiometer**, **LCD pin 2 (VDD)**, and **LCD pin 15 (LED+)**.
- Connect **Pi ground** to the **ground rail of the breadboard**. From the ground rail connect the **other outer lead of the potentiometer**, **LCD pin 1 (VSS)**, and **LCD pin 5 (R/W)**.
- Connect the **middle lead of the potentiometer** to **LCD pin 3 (V0/contrast)**.
- Connect **Pi pin 27 (or 21 on older revision Pi's)** to **LCD pin 4 (RS)**.
- Connect **Pi pin 22** to **LCD pin 6 (E/clock enable)**.
- Connect **Pi pin 25** to **LCD pin 11 (DB4)**.
- Connect **Pi pin 24** to **LCD pin 12 (DB5)**.
- Connect **Pi pin 23** to **LCD pin 13 (DB6)**.
- Connect **Pi pin 18** to **LCD pin 14 (DB7)**.
- Connect **Pi pin 4** to **LCD pin 16 (-R/red)**.
- Connect **Pi pin 17** to **LCD pin 17 (-G/green)**.
- Connect **Pi pin 7 / CE1** to **LCD pin 18 (-B/blue)**.

BeagleBone Black

Wire your BeagleBone Black to the LCD as follows. If you aren't familiar with how to identify pins on the board, be sure to read the BeagleBone Black GPIO guide (http://adafru.it/dCI).

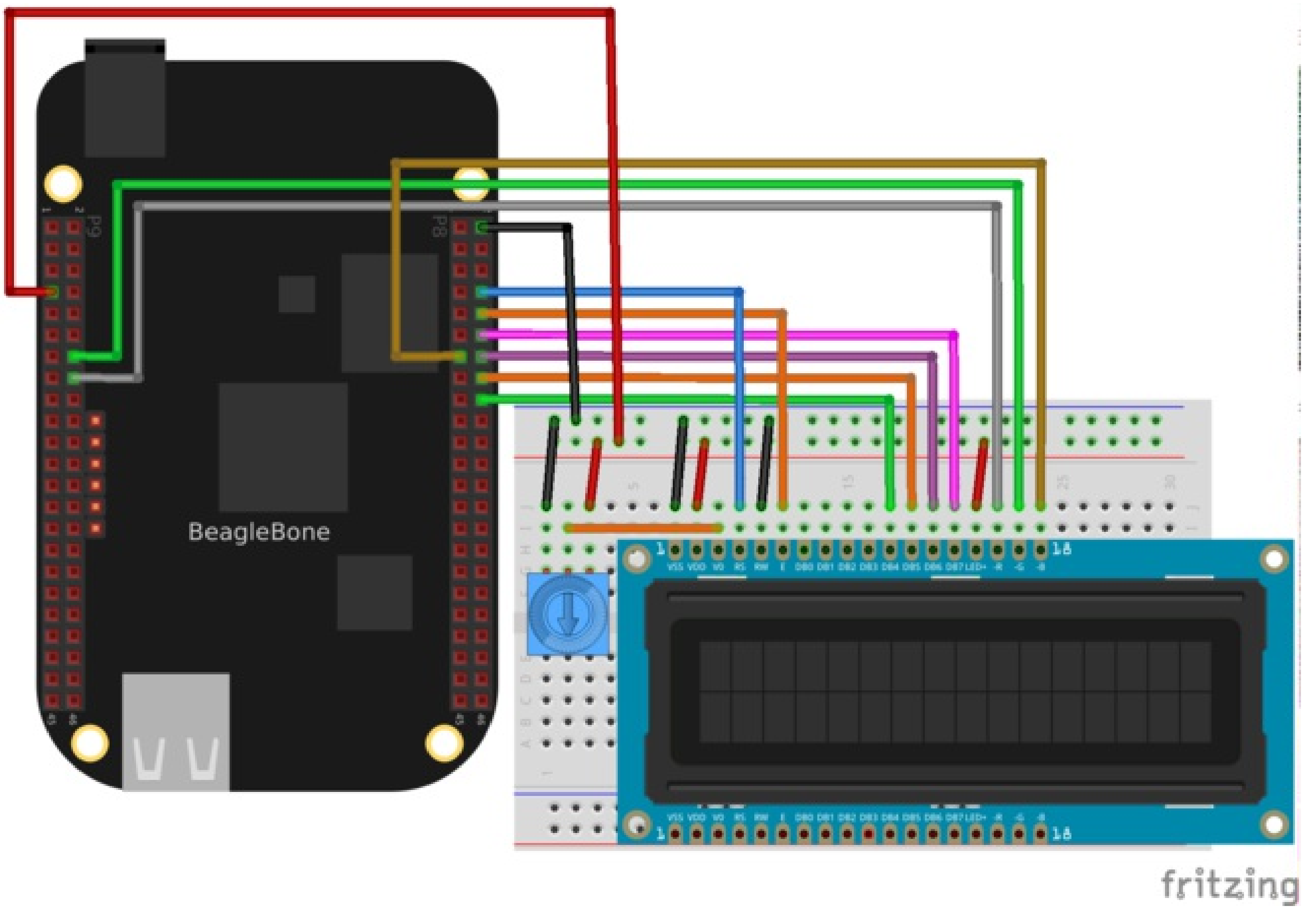

BeagleBone
P9
VSS VDD V0 RS RW E DB0 DB1 DB2 DB3 DB4 DB5 DB6 DB7 LED+ -R -G -B
18
fritzing

- Connect **BeagleBone Black 5V power pin P9_7** to the **power rail of the breadboard**. From the power rail connect **one outer lead of the potentiometer**, **LCD pin 2 (VDD)**, and **LCD pin 15 (LED+)**.
- Connect **BeagleBone Black ground pin P8_2** to the **ground rail of the breadboard**. From the ground rail connect the **other outer lead of the potentiometer**, **LCD pin 1 (VSS)**, and **LCD pin 5 (R/W)**.
- Connect the **middle lead of the potentiometer** to **LCD pin 3 (V0/contrast)**.
- Connect **BeagleBone Black pin P8_8** to **LCD pin 4 (RS)**.
- Connect **BeagleBone Black pin P8_10** to **LCD pin 6 (E/clock enable)**.
- Connect **BeagleBone Black pin P8_18** to **LCD pin 11 (DB4)**.
- Connect **BeagleBone Black pin P8_16** to **LCD pin 12 (DB5)**.
- Connect **BeagleBone Black pin P8_14** to **LCD pin 13 (DB6)**.
- Connect **BeagleBone Black pin P8_12** to **LCD pin 14 (DB7)**.
- Connect **BeagleBone Black pin P8_7** to **LCD pin 16 (-R/red)**.
- Connect **BeagleBone Black pin P8_9** to **LCD pin 17 (-G/green)**.
- Connect **BeagleBone Black pin P8_11** to **LCD pin 18 (-B/blue)**.

BeagleBone Black with PWM

The above wiring will use digital IO to control the colors of the backlight display. This means the backlight can only show 7 different colors (all the combinations of the 3 backlight LEDs). However because the BeagleBone Black supports PWM (pulse-width modulation) control of some hardware pins, it's possible to use PWM pins to control the backlight LEDs and display a range of almost all colors.

To use PWM control of the backlight LEDs, wire your BeagleBone Black to the LCD as follows. Note that this wiring is exactly the same as the non-PWM wiring, except the 3 backlight LED pins (red, green, blue) are moved to different pins.


BeagleBone
P9
P8
VSS VDD V0 RS RW E DB0 DB1 DB2 DB3 DB4 DB5 DB6 DB7 LED+ -R -G -B
fritzing

- Connect **BeagleBone Black 5V power pin P9_7** to the **power rail of the breadboard**. From the power rail connect **one outer lead of the potentiometer**, **LCD pin 2 (VDD)**, and **LCD pin 15 (LED+)**.
- Connect **BeagleBone Black ground pin P8_2** to the **ground rail of the breadboard**. From the ground rail connect the **other outer lead of the potentiometer**, **LCD pin 1 (VSS)**, and **LCD pin 5 (R/W)**.
- Connect the **middle lead of the potentiometer** to **LCD pin 3 (V0/contrast)**.
- Connect **BeagleBone Black pin P8_8** to **LCD pin 4 (RS)**.
- Connect **BeagleBone Black pin P8_10** to **LCD pin 6 (E/clock enable)**.
- Connect **BeagleBone Black pin P8_18** to **LCD pin 11 (DB4)**.
- Connect **BeagleBone Black pin P8_16** to **LCD pin 12 (DB5)**.
- Connect **BeagleBone Black pin P8_14** to **LCD pin 13 (DB6)**.
- Connect **BeagleBone Black pin P8_12** to **LCD pin 14 (DB7)**.
- Connect **BeagleBone Black pin P9_16** to **LCD pin 16 (-R/red)**.
- Connect **BeagleBone Black pin P9_14** to **LCD pin 17 (-G/green)**.
- Connect **BeagleBone Black pin P8_13** to **LCD pin 18 (-B/blue)**.

Usage

Dependencies

Before installing the character LCD library you'll need to make sure a few dependencies are installed by following the steps below. Make sure your development board has access to the internet so the software can be downloaded.

Raspberry Pi

On the Raspberry Pi execute the following commands in a terminal/SSH session on the Pi:

```
sudo apt-get update
sudo apt-get install build-essential python-dev python-smbus python-pip git
sudo pip install RPi.GPIO
```

You can ignore any warnings about dependencies already being installed.

BeagleBone Black

On the BeagleBone Black execute the following commands in a terminal/SSH session on the device:

```
sudo apt-get update
sudo apt-get install build-essential python-dev python-smbus python-pip git
sudo pip install Adafruit_BBIO
```

You can ignore any warnings about dependencies already being installed.

Installation

Once the dependencies above have been installed you can install the character LCD module by executing the following commands on the device:

```
cd ~
git clone https://github.com/adafruit/Adafruit_Python_CharLCD.git
cd Adafruit_Python_CharLCD
sudo python setup.py install
```

These commands will clone the GitHub repository with the library source (http://adafru.it/dJo) and then execute the **setup.py** script to install the library.

Usage

Once the library is installed you can find a few examples of its usage in the **examples** subdirectory. If you're using a monochrome backlight LCD (i.e. single color, like a white on blue LCD) the **char_lcd.py** script will demonstrate the basic usage.

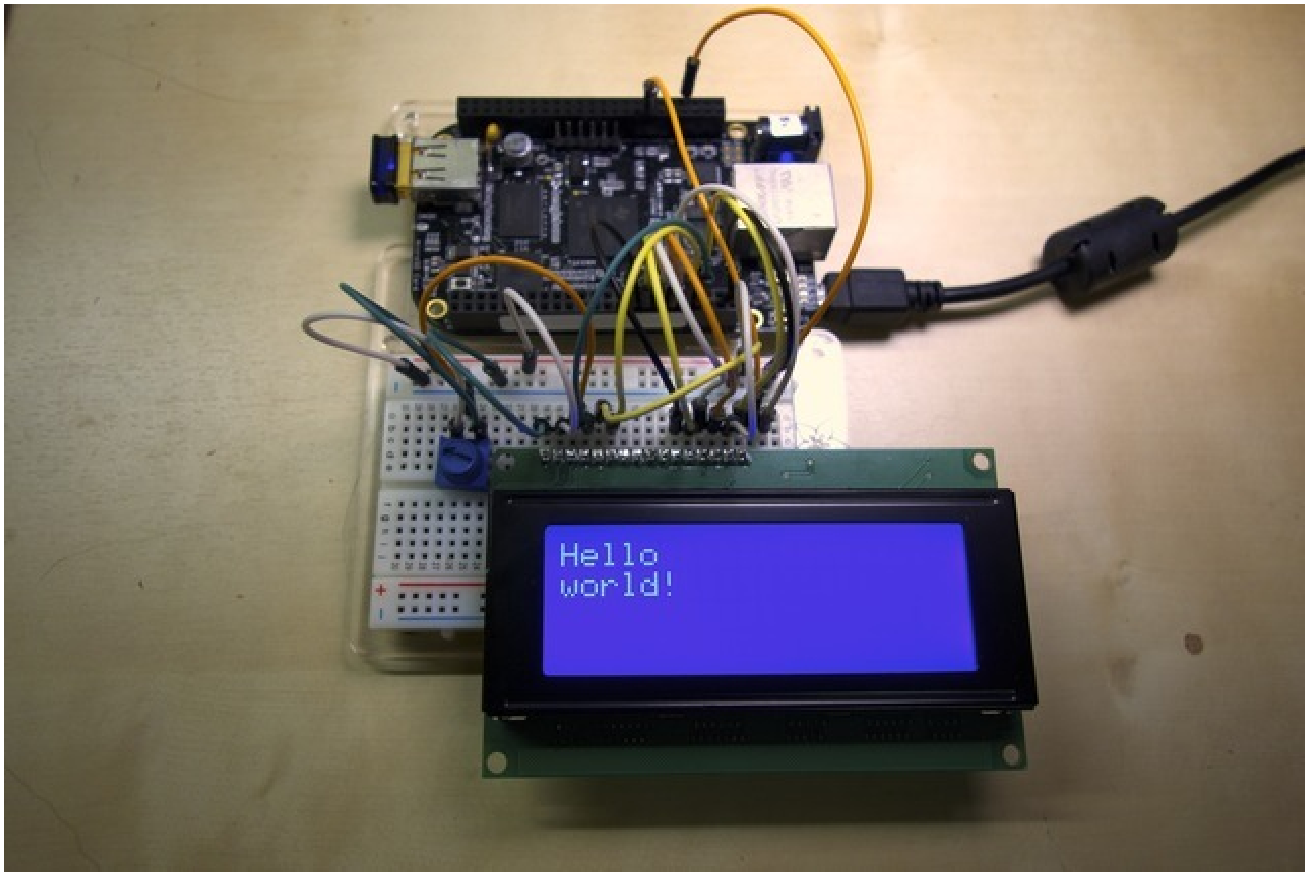
If you're using a Raspberry Pi and have wired it according to this guide, you can immediately run the example. However if you're using a BeagleBone Black or changed the wiring, first open **char_lcd.py** in a text editor (like nano) and uncomment/comment the lines towards the top that set the LCD pins.

Note: If you're using a BeagleBone Black wired for hardware PWM of the backlight, skip down the page to the section on using hardware PWM.

To run the example execute:

```
cd examples
python char_lcd.py
```

You should see the LCD backlight turn on and messages printed to the display. For example below is what you will see with a 20x4 blue backlight LCD:



To demonstrate the usage of the library I'll walk through the source code of the **char_lcd.py** example below.

```
import math
import time

import Adafruit_CharLCD as LCD
```

The first part of the script are commands to import modules that will be used. In particular the **Adafruit_CharLCD** module is imported under the name LCD. Later in the script you can see how classes from the char LCD module are used to interact with the LCD.

```
# Raspberry Pi pin configuration:
lcd_rs        = 27  # Note this might need to be changed to 21 for older revision Pi's.
lcd_en        = 22
lcd_d4        = 25
lcd_d5        = 24
lcd_d6        = 23
lcd_d7        = 18
lcd_backlight = 4

# BeagleBone Black configuration:
# lcd_rs        = 'P8_8'
# lcd_en        = 'P8_10'
# lcd_d4        = 'P8_18'
# lcd_d5        = 'P8_16'
# lcd_d6        = 'P8_14'
# lcd_d7        = 'P8_12'
# lcd_backlight = 'P8_7'
```

The next part of the script configures which pins are connected to the LCD. You can see the Raspberry Pi configuration is uncommented by default, and below it the BeagleBone Black configuration is commented. You can use any digital GPIO pins in the configuration.

```
# Define LCD column and row size for 16x2 LCD.
lcd_columns = 16
lcd_rows    = 2

# Alternatively specify a 20x4 LCD.
# lcd_columns = 20
# lcd_rows    = 4
```

This section of the script configures the size of the LCD. By default the code assumes a 16 column, 2 row LCD however you can adjust the configuration to a 20x4 or other size display supported by the HD44780.

```
# Initialize the LCD using the pins above.
lcd = LCD.Adafruit_CharLCD(lcd_rs, lcd_en, lcd_d4, lcd_d5, lcd_d6, lcd_d7,
                           lcd_columns, lcd_rows, lcd_backlight)
```

Next an instance of the **Adafruit_CharLCD** class is created based on the configuration specified earlier in the script.

```
# Print a two line message
lcd.message('Hello\nworld!')

# Wait 5 seconds
time.sleep(5.0)

# Demo showing the cursor.
lcd.clear()
lcd.show_cursor(True)
lcd.message('Show cursor')

time.sleep(5.0)

# Demo showing the blinking cursor.
lcd.clear()
lcd.blink(True)
lcd.message('Blink cursor')

time.sleep(5.0)

# Stop blinking and showing cursor.
lcd.show_cursor(False)
lcd.blink(False)
```

The next lines demonstrate basic usage of the LCD display class. The **message** function can be used to write a string of text to the display (including support for line breaks). The **clear** function clears the display, and the **show_cursor** and **blink** functions specify if the cursor is shown and should blink.

Although not shown above, there are other functions you might find useful on the LCD class. To see details on all functions you can have Python print help text for the class by executing (ignore the >>> prompt, it's only shown for reference as the Python interpreter):

```
python
>>> import Adafruit_CharLCD as LCD
>>> help(LCD.Adafruit_CharLCD)
```

You should see a description of each function on the LCD class, including some functions not shown in the example:

- **autoscroll(autoscroll)**
  - Autoscroll will 'right justify' text from the cursor if set True, otherwise it will 'left justify' the text.
- **enable_display(enable)**
  - Enable or disable the display. Set enable to True to enable.
- **home()**
  - Move the cursor back to its home (first line and first column).
- **set_backlight(backlight)**
  - Enable or disable the backlight. If PWM is not enabled (default), a non-zero backlight value will turn on the backlight and a zero value will turn it off. If PWM is enabled, backlight can be any value from 0.0 to 1.0, with 1.0 being full intensity backlight.
- **set_cursor(col, row)**
  - Move the cursor to an explicit column and row position.

Finally, the last portion of the **char_lcd.py** script:

```
# Demo scrolling message right/left.
lcd.clear()
message = 'Scroll'
lcd.message(message)
for i in range(lcd_columns-len(message)):
 time.sleep(0.5)
 lcd.move_right()
for i in range(lcd_columns-len(message)):
 time.sleep(0.5)
 lcd.move_left()

# Demo turning backlight off and on.
lcd.clear()
lcd.message('Flash backlight\nin 5 seconds...')
time.sleep(5.0)
# Turn backlight off.
lcd.set_backlight(0)
time.sleep(2.0)
# Change message.
lcd.clear()
lcd.message('Goodbye!')
```

```
# Turn backlight on.
lcd.set_backlight(1)
```

You can see how the **move_right** and **move_left** functions are used to scroll the display, and further down how the **set_backlight** function turns off and on the backlight.

That's all there is to using the **Adafruit_CharLCD** class!

RGB Character LCD

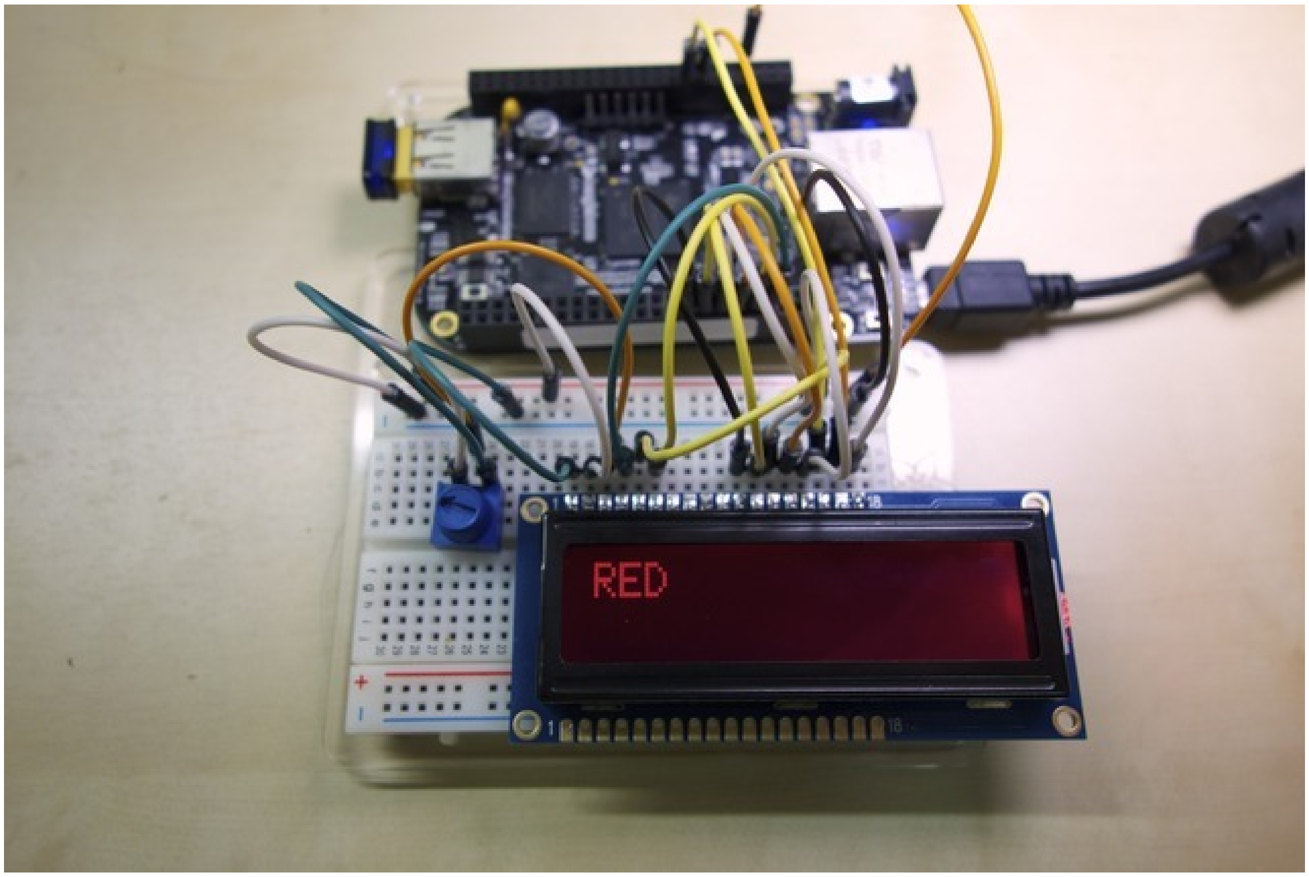
If you're using an RGB backlight LCD the **char_lcd_rgb.py** script will demonstrate the usage.

If you're using a Raspberry Pi and have wired it according to this guide, you can immediately run the script. However if you're using a BeagleBone Black or have changed the wiring, edit the script with a text editor and uncomment/change the lines at the top that define the LCD pins.

To execute the RGB backlight example run this command from inside the **examples** directory:

```
sudo python char_lcd_rgb.py
```

You should see the LCD turn on and display different backlight colors. For example:



If you open the file **char_lcd_rgb.py** in a text editor (such as nano) I'll describe the important differences between it and the previous **char_lcd.py** example below.

```
# Example Raspberry Pi configuration:
lcd_rs = 27  # Change this to pin 21 on older revision Raspberry Pi's
lcd_en = 22
lcd_d4 = 25
lcd_d5 = 24
lcd_d6 = 23
lcd_d7 = 18
lcd_red   = 4
lcd_green = 17
lcd_blue  = 7  # Pin 7 is CE1

# Example BeagleBone Black configuration:
# lcd_rs = 'P8_8'
# lcd_en = 'P8_10'
# lcd_d4 = 'P8_18'
# lcd_d5 = 'P8_16'
# lcd_d6 = 'P8_14'
# lcd_d7 = 'P8_12'
# lcd_red   = 'P8_7'
# lcd_green = 'P8_9'
# lcd_blue  = 'P8_11'
```

The first important difference is the configuration of LCD pins. Notice there are now explicit pins defined for the red, green, and blue backlight LEDs.

```
# Initialize the LCD using the pins
lcd = LCD.Adafruit_RGBCharLCD(lcd_rs, lcd_en, lcd_d4, lcd_d5, lcd_d6, lcd_d7,
                              lcd_columns, lcd_rows, lcd_red, lcd_green, lcd_blue)
```

The next line creates an instance of the **Adafruit_RGBCharLCD** class using the pin configuration defined earlier.

The **Adafruit_RGBCharLCD** class inherits from the **Adafruit_CharLCD** class so it has all the same functionality as demonstrated in the **char_lcd.py** example. In addition to the basic character LCD functionality the RGB character LCD class adds some functions to set the RGB color of the backlight.

```
# Show some basic colors.
lcd.set_color(1.0, 0.0, 0.0)
lcd.clear()
lcd.message('RED')
time.sleep(3.0)

lcd.set_color(0.0, 1.0, 0.0)
lcd.clear()
lcd.message('GREEN')
time.sleep(3.0)

lcd.set_color(0.0, 0.0, 1.0)
lcd.clear()
lcd.message('BLUE')
time.sleep(3.0)

lcd.set_color(1.0, 1.0, 0.0)
lcd.clear()
lcd.message('YELLOW')
time.sleep(3.0)

lcd.set_color(0.0, 1.0, 1.0)
lcd.clear()
lcd.message('CYAN')
time.sleep(3.0)
```

```
lcd.set_color(1.0, 0.0, 1.0)
lcd.clear()
lcd.message('MAGENTA')
time.sleep(3.0)

lcd.set_color(1.0, 1.0, 1.0)
lcd.clear()
lcd.message('WHITE')
time.sleep(3.0)
```

The code above demonstrates each basic color by calling the **set_color** function and passing in which red, green, and blue LEDs to enable. For example the first call to **set_color(1.0, 0.0, 0.0)** will turn on the **red** LED and turn off the green and blue LED so the backlight will have a **red** color.

Notice how later lines combine multiple LEDs to get different colors, like calling **set_color(1.0, 0.0, 1.0)** to combine **red** and **blue** LEDs for a **magenta/violet** color.

RGB Character LCD with PWM

If you're using a RGB character LCD you can use PWM (pulse-width modulation) for fine control of the backlight color. By turning the different backlight red, green, and blue LEDs on and off very quickly with PWM, it's possible to precisely control the color of the backlight.

Note that PWM control works best when there's hardware support for PWM on your development board. The BeagleBone Black has support for up to 8 hardware controlled PWM pins (http://adafru.it/dvk) and works great with the RGB character LCDs. However, the Raspberry Pi only has one hardware PWM pin and can be a little more troublesome to use PWM.

The RPi.GPIO library which is used by the character LCD library supports a software implementation of PWM on the Raspberry Pi. This lets you PWM control the RGB backlight even though the Pi doesn't have 3 hardware PWM pins. In my testing software PWM worked reasonably well with the RGB character LCD backlight. You might notice slightly incorrect colors, but otherwise software PWM is worth a shot to finely adjust the backlight color on the Raspberry Pi.

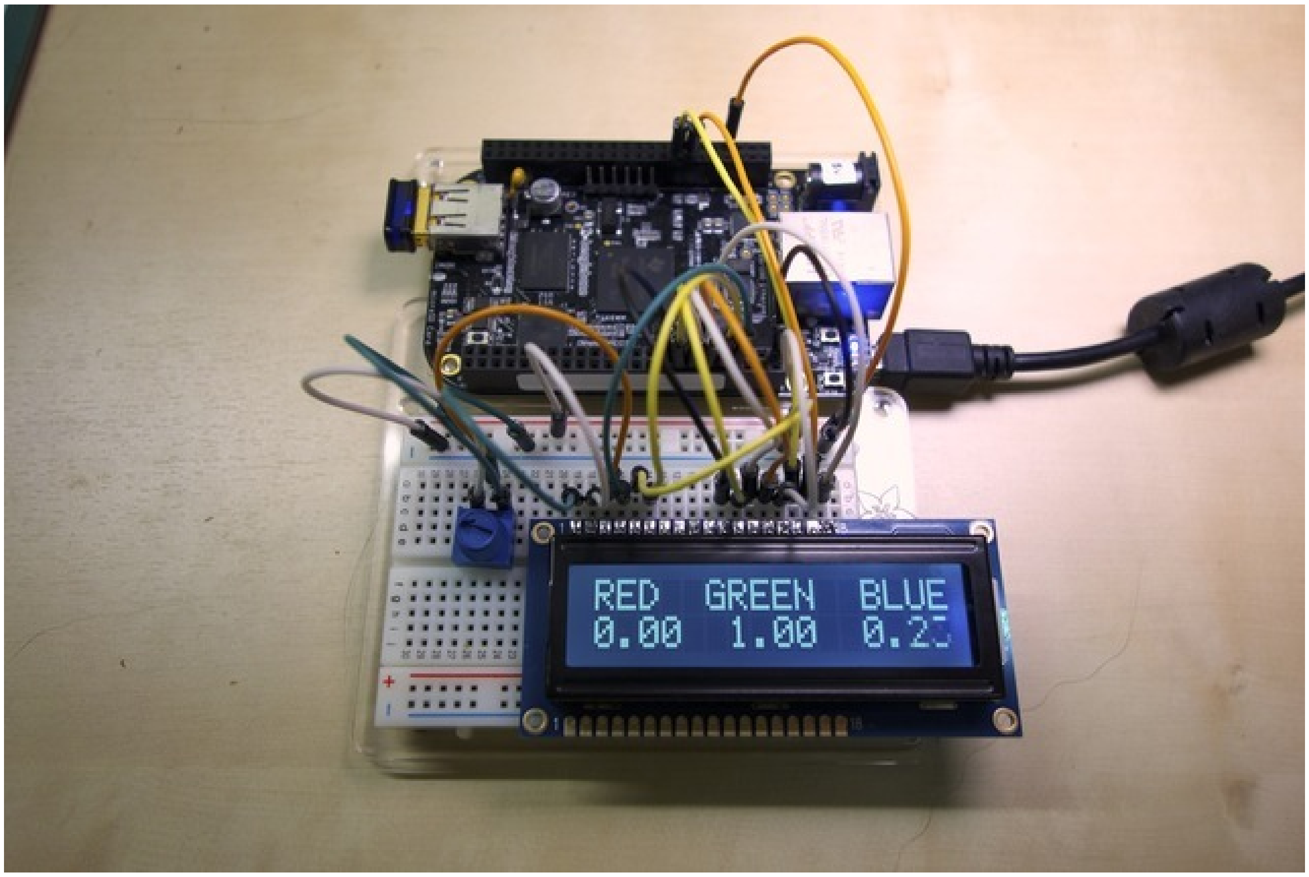
The **char_lcd_rgb_pwm.py** file demonstrates usage of PWM backlight control. If you're using a Raspberry Pi and have it wired to the LCD as described in this guide, you can immediately run the script. However if you have a BeagleBone Black or have changed the wiring, edit the file **char_lcd_rgb_pwm.py** in a text editor and comment/uncomment the lines at the top which define the LCD pins.

If you're using the BeagleBone Black make sure you've followed the wiring for hardware PWM. Specifically, the red, green, and blue backlight pins need to be connected to the P9_16, P9_14, and P8_13 pins respectively.

To run the example, make sure you're in the **examples** folder and run:

```
sudo python char_lcd_rgb_pwm.py
```

You should see the backlight turned on to different colors for a short period of time, and then a continuous gradient of colors displayed with a message showing the red, green, and blue color displayed on the LCD. For example:



You can press **Ctrl-C** to top the script.

The code for PWM control is very similar to non-PWM control from **char_lcd_rgb.py**, however there are a few important differences. The first difference is how the **Adafruit_RGBCharLCD** class is intialized. Notice the **enable_pwm=True** flag is passed to the constructor/init function:

```
# Initialize the LCD using the pins
lcd = LCD.Adafruit_RGBCharLCD(lcd_rs, lcd_en, lcd_d4, lcd_d5, lcd_d6, lcd_d7,
                              lcd_columns, lcd_rows, lcd_red, lcd_green, lcd_blue,
                              enable_pwm=True)
```

When PWM is enabled, the **set_color** function can be passed any value from 0.0 to 1.0 for each color component. By finely adjusting each component you can get precise control over the backlight color.

For example a reddish-blue color might have full red intensity and half blue intensity by calling **set_color(1.0, 0.0, 0.5)**. Or a gray/dim white color might have all color components at one quarter intensity by calling **set_color(0.25, 0.25, 0.25)**. Experiment with different component values to see what interesting colors you can find.

In the example code you can see how the HSV (http://adafru.it/dJs) (hue, saturation, value) color space is used to show the full spectrum of colors. Feel free to use the HSV color function in the example in your own scripts.

MCP230xx IO Expander

One problem with using a character LCD is that you give up a lot of GPIO pins to talk to the LCD. Four pins are used to send data, two pins are used for write and clock signals, and another pin or three are used for the backlight for a total of ~6-9 total pins! On a platform like the Raspberry Pi model A/B with only a dozen or so GPIO pins you can quickly run out of pins for other parts of your project. However with chips like the MCP23008 (http://adafru.it/593) or MCP23017 (http://adafru.it/732) you can easily add extra GPIO pins to your development board through an I2C interface!

If you aren't familiar with the MCP230xx series of chips, there's a great guide that describes their usage with a Raspberry Pi (http://adafru.it/dJt). Note that you don't need to install the library or code from the guide, it's only provided for reference.

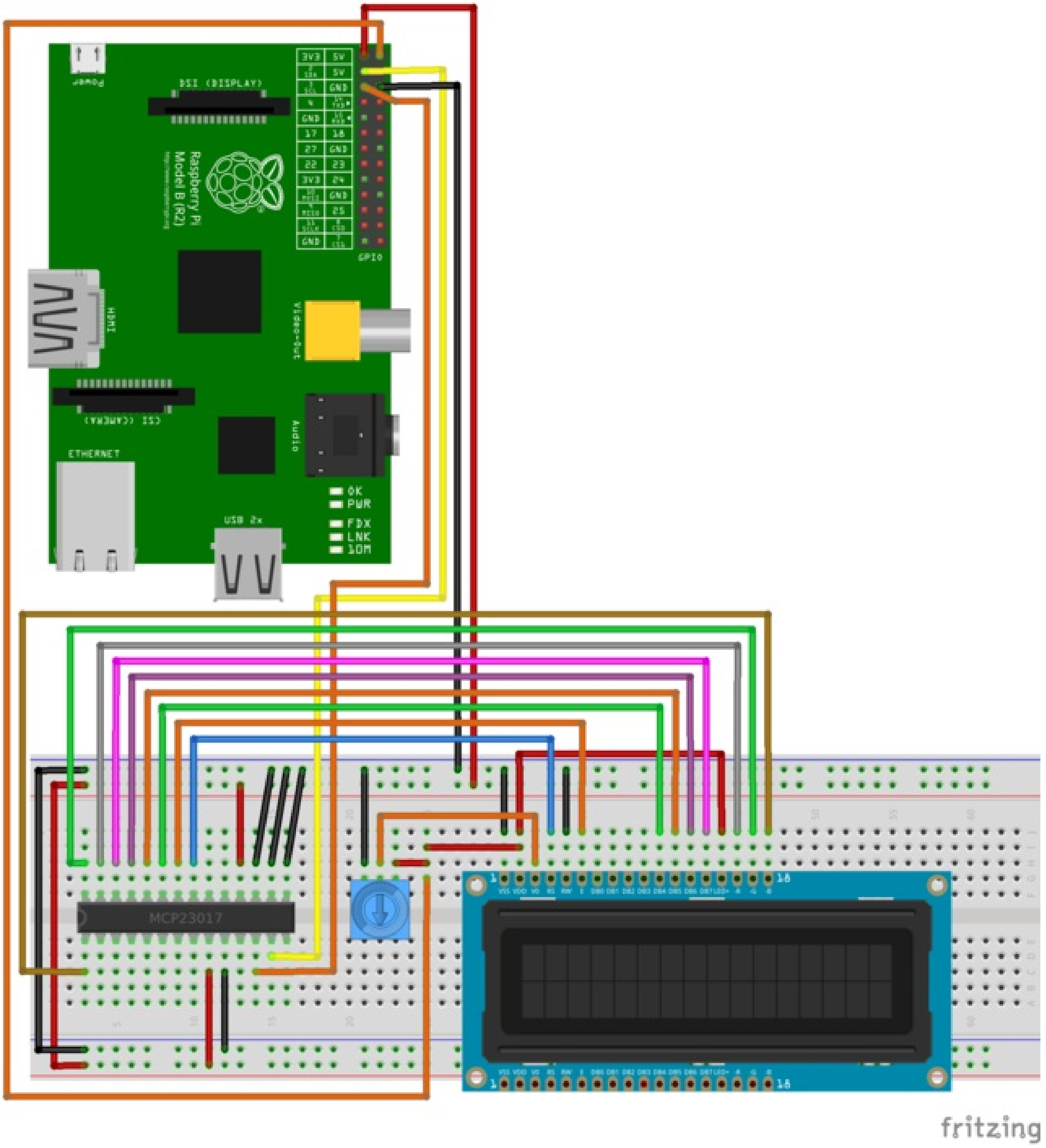
Wiring

To use an MCP230xx chip with a character LCD you will need to wire the MCP chip to your board's I2C pins, and then wire the LCD to the MCP chip. Below are examples of wiring an MCP23017 to the Raspberry Pi or BeagleBone Black.

If you'd like to use an MCP23008 instead of the MCP23017 the wiring is similar, however consult the MCP23008 datasheet (http://adafru.it/dJu) to see which pins are for power, ground, I2C, and GPIO.

Raspberry Pi

Wire your MCP23017 and LCD as follows:



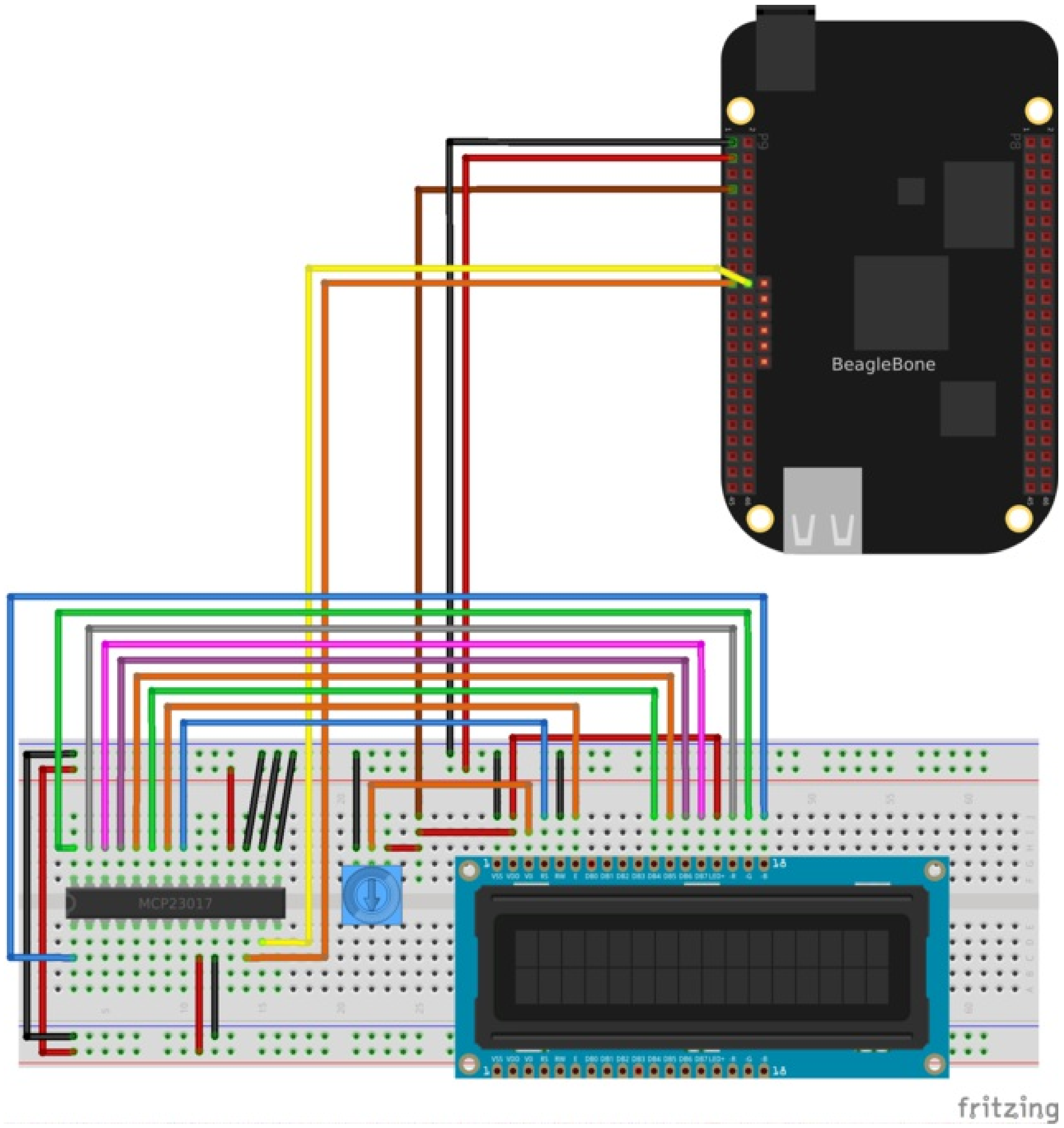
- Connect **Pi 3.3V power** to the **power rail** of the breadboard, and connect the **MCP VDD** and **RESET** to 3V power. **Be careful to connect the 3.3 volt and not 5 volt power to these pins!**
- Connect **Pi ground** to the **ground rail** of the breadboard, and connect the **MCP VSS** and **address pins**, one **outer lead of the potentiometer**, the **LCD ground**, and the **LCD R/W** pin to the ground rail.
- Connect **Pi 5V power** to the other **outer lead of the potentiometer**, **LCD power**, and **LCD backlight+** pins. **Note that 5 volt and not 3.3 volt power is**

used to power the LCD!
- Connect the **middle pin of the potentiometer** to the **LCD contrast/V0** pin.
- Connect **Pi I2C SCL** to **MCP I2C SCL.**
- Connect **Pi I2C SDA** to **MCP I2C SDA**.
- Connect **MCP GPIOA0** to **LCD RS**.
- Connect **MCP GPIOA1** to **LCD EN/clock enable**.
- Connect **MCP GPIOA2** to **LCD DB4**.
- Connect **MCP GPIOA3** to **LCD DB5**.
- Connect **MCP GPIOA4** to **LCD DB6**.
- Connect **MCP GPIOA5** to **LCD DB7**
- Connect **MCP GPIOA6** to **LCD -R/red backlight**.
- Connect **MCP GPIOA7** to **LCD -G/green backlight**.
- Connect **MCP GPIOB0** to **LCD -B/blue backlight**.

Make sure you've enabled I2C on the Raspberry Pi (http://adafru.it/dEO) **if you haven't done so already.**

BeagleBone Black

Wire your MCP23017 and LCD as follows:



- Connect **BeagleBone Black 3.3V power pin P9_3** to the **power rail** of the breadboard, and connect the **MCP VDD** and **RESET** to 3V power. **Be careful to connect the 3.3 volt and not 5 volt power to these pins!**
- Connect **BeagleBone Black ground pin P9_1** to the **ground rail** of the breadboard, and connect the **MCP VSS** and **address pins**, one **outer lead of the potentiometer**, the **LCD ground**, and the **LCD R/W** pin to the ground rail.
- Connect **BeagleBone Black 5V power pin P9_7** to the other **outer lead of the potentiometer**, **LCD power**, and **LCD backlight+** pins. **Note that 5 volt and not 3.3 volt power is used to power the LCD!**

- Connect the **middle pin of the potentiometer** to the **LCD contrast/V0** pin.
- Connect **BeagleBone Black I2C SCL pin P9_19** to **MCP I2C SCL.**
- Connect **BeagleBone Black I2C SDA pin P9_20** to **MCP I2C SDA**.
- Connect **MCP GPIOA0** to **LCD RS**.
- Connect **MCP GPIOA1** to **LCD EN/clock enable**.
- Connect **MCP GPIOA2** to **LCD DB4**.
- Connect **MCP GPIOA3** to **LCD DB5**.
- Connect **MCP GPIOA4** to **LCD DB6**.
- Connect **MCP GPIOA5** to **LCD DB7**
- Connect **MCP GPIOA6** to **LCD -R/red backlight**.
- Connect **MCP GPIOA7** to **LCD -G/green backlight**.
- Connect **MCP GPIOB0** to **LCD -B/blue backlight**.

Note that the BeagleBone Black has two I2C interfaces and this wiring will use the**/dev/i2c-1** interface. Make sure there aren't any device tree overlays loaded (http://adafru.it/dp6) which use these I2C pins for other purposes. The default BeagleBone Black device tree configuration with no overlays loaded will expose the necessary I2C interface for the wiring above.

Usage

The **char_lcd_mcp.py** file in the library's examples folder demonstrates the usage of a character LCD (non-RGB version) with an MCP23017 IO extender. Run the script by executing this command inside the examples directory:

```
sudo python char_lcd_mcp.py
```

You should see a simple demo of the LCD displaying text, cursors, and scrolling just like the **char_lcd.py** demo described on the previous page.

If you open **char_lcd_mcp.py** in a text editor you can see how to use the character LCD library with the MCP chip. Below is an overview of the file:

```
import math
import time

import Adafruit_CharLCD as LCD
import Adafruit_GPIO.MCP230xx as MCP
```

First the required modules are imported. Notice the addition of the **Adafruit_GPIO.MCP230xx** module (imported under the name MCP). This MCP230xx class will be used to talk to the MCP chip and interface with the LCD.

```
# Define MCP pins connected to the LCD.
lcd_rs        = 0
lcd_en        = 1
lcd_d4        = 2
lcd_d5        = 3
lcd_d6        = 4
lcd_d7        = 5
lcd_backlight = 6
# Optionally if the backlight is not controllable then set:
# lcd_backlight = None

# Define LCD column and row size for 16x2 LCD.
lcd_columns = 16
lcd_rows    = 2

# Alternatively specify a 20x4 LCD.
# lcd_columns = 20
# lcd_rows    = 4
```

Next the LCD pins are defined in the script. **Note that these pin numbers are the MCP chip GPIO pin numbers, and NOT Raspberry Pi/BeagleBone Black pin numbers!**

```
# Initialize MCP23017 device using its default 0x20 I2C address.
gpio = MCP.MCP23017()

# Alternatively you can initialize the MCP device on another I2C address or bus.
# gpio = MCP.MCP23017(0x24, busnum=1)
```

Next an instance of the MCP23017 class is created. By default this class will use the I2C address 0x20 (default for MCP chips) and appropriate I2C bus for the running development board. However if you need to override the address or bus number you can see in the commented line how these are passed as parameters.

Also note if you're using an MCP23008 chip you can instead create an instance of the **MCP23008** class. This class is exactly the same as the **MCP23017** class, but only supports 8 GPIO pins.

```
# Initialize the LCD using the pins
lcd = LCD.Adafruit_CharLCD(lcd_rs, lcd_en, lcd_d4, lcd_d5, lcd_d6, lcd_d7,
                           lcd_columns, lcd_rows, lcd_backlight, gpio=gpio)
```

Now the **Adafruit_CharLCD** class instance is created. The big difference with this line and previous examples is that the MCP23017 class (created with the name 'gpio') is passed in as the **gpio** parameter. By passing in an explicit gpio parameter, the char LCD class will use that GPIO class for talking to the LCD instead of the default development board GPIO pins.

The rest of the example code is exactly the same as the non-MCP character LCD example. You only need to change the setup and initialization of the character LCD class to use the MCP IO extender with an LCD!

Note you can also use an RGB character LCD with an MCP IO extender, however the MCP IO extender does NOT support PWM control of the backlight!

Raspberry Pi Char LCD Plate

The character LCD plate is a great way to add a simple character LCD and buttons to your Raspberry Pi project. Because the character LCD plate is based on the MCP23017 IO expander, the character LCD library easily supports the character LCD plate!

If you aren't familiar with the character LCD plate, make sure to first read the guide on its usage (http://adafru.it/dJv).

To use this character LCD library with the plate, make sure the library is installed by following the steps on the usage page. Then connect the LCD plate to your Raspberry Pi and execute the **char_lcd_plate.py** script in the library's **examples** folder:

```
sudo python char_lcd_plate.py
```

Note that the example assumes an RGB character LCD is attached to the plate, however it will still run with a monochrome LCD (you just might see the backlight turn on and off in different ways as colors as displayed).

When you run the example you should see the backlight run through different colors, and then the display will tell you to press buttons. If you press different buttons on the LCD plate you should see the button name and a different color displayed. Try pressing buttons to see how the script reacts!

Examine the code for the char_lcd_plate.py script to see how to use the character LCD plate code. The usage of the LCD plate is very similar to RGB or monochrome LCD usage, with a few key differences.

The first difference is that you create and instance of the **Adafruit_CharLCDPlate** class. You don't need to pass any parameters in to this class' constructor/init function because it is preconfigured for the LCD plate.

```
# Initialize the LCD using the pins
lcd = LCD.Adafruit_CharLCDPlate()
```

The second difference is that the **Adafruit_CharLCDPlate** adds a function to test if a button is pressed. Notice how the **is_pressed** function is called for each button, and if it returns True then the button press is detected.

For example to check if the select button is pressed you can call **is_presssed(LCD.SELECT)**, or to check if the right button is pressed you can call **is_pressed(LCD.RIGHT)**.

```
# Make list of button value, text, and backlight color.
buttons = ( (LCD.SELECT, 'Select', (1,1,1)),
            (LCD.LEFT,   'Left'  , (1,0,0)),
            (LCD.UP,     'Up'    , (0,0,1)),
            (LCD.DOWN,   'Down'  , (0,1,0)),
            (LCD.RIGHT,  'Right' , (1,0,1)) )

print 'Press Ctrl-C to quit.'
while True:
 # Loop through each button and check if it is pressed.
 for button in buttons:
  if lcd.is_pressed(button[0]):
   # Button is pressed, change the message and backlight.
   lcd.clear()
   lcd.message(button[1])
   lcd.set_color(button[2][0], button[2][1], button[2][2])
```

One final thing to note, just like using an MCP230xx IO extender the character LCD plate does not support PWM control of the backlight LEDs!

That's all there is to using the character LCD plate with the character LCD Python library!