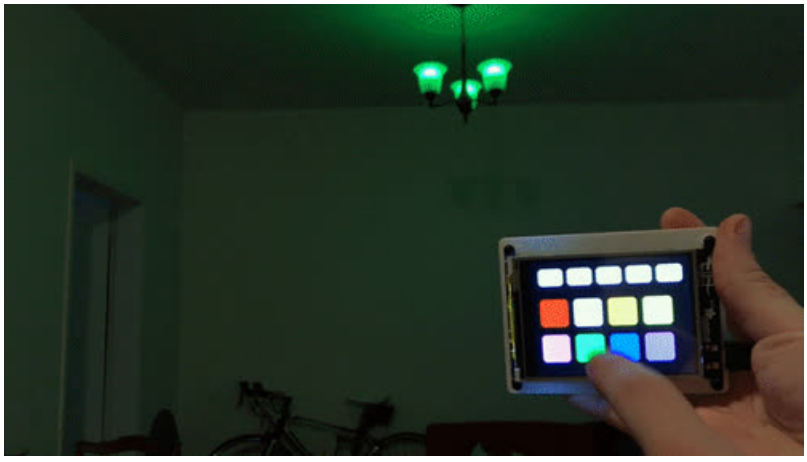
adafruit learning system

PyPortal Philips Hue Lighting Controller

Created by Brent Rubell



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Overview

Want to create the right atmosphere to match your mood?

The **Philips Hue** (https://adafru.it/Ezq) is the most intelligent lighting system on the market. The Hue system is comprised of a bridge which communicates over the Internet and smart lights. There's ***lots* of different types of lights** to connect to the Hue Bridge - from bulbs to LED strips.

With Hue, **you can set light colors** to transform the mood of a room, **create lighting profiles** for different scenarios, create light profiles to wake up to, and even **control lights outside of your home** .

- You can **browse the entire Philips Hue product line on their website here** (https://adafru.it/Ezr).

In this guide, you'll be building a touchscreen lighting controller with an Adafruit PyPortal to control a light, or groups of lights, connected to a Philips Hue bridge.

- 

The **Philips Hue** lighting system revolves around the **Hue Bridge**. This bridge is connected to your router and communicates *wirelessly* over radio (in a format called ZigBee) to Hue lights and devices linked to the bridge.

Instead of including a separate WiFi radio in each bulb, which increases the number of WiFi devices on your router, *only the hub is connected to your router*.

If you're looking for a way to **interactively control Philips Hue Lights with CircuitPython**, follow along!

- 

CircuitPython Code

CircuitPython is perfect for building Internet-of-Things projects. This project uses the ESP32SPI CircuitPython (https://adafru.it/DWV)library, which can use the ESP32 as a WiFi-coprocessor to send web requests to the LIFX HTTP Remote Control API.

We've also built a Philips Hue helper module for CircuitPython (https://adafru.it/Ezs) to make interfacing with Hue incredibly easy.

You can rapidly update your code without having to compile and store WiFi and API secret keys on the device. This means that there's no editing code and re-uploading whenever you move the PyPortal to another network - just update a file and you're set.

- 

PyPortal

Say hello to PyPortal! The easiest way to build your IoT projects with a touchscreen display!

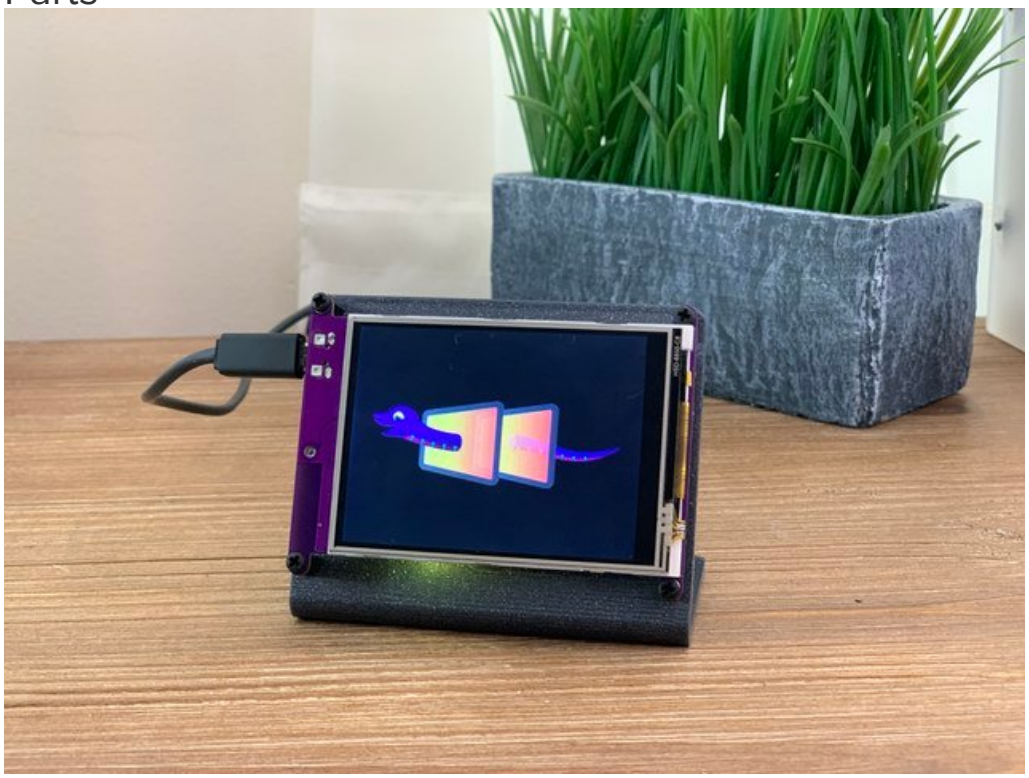
Make sure to walk through the PyPortal introduction guide and walkthrough the pages. It'll get you setup with CircuitPython and a handful of demo code to play with! (https://adafru.it/Ecp)

Prerequisite Guides

If you're new to CircuitPython, take a moment to walk through the following guides to get you started and up-to-speed:

- Welcome to CircuitPython (https://adafru.it/cpy-welcome)
- PyPortal Introduction Guide (https://adafru.it/Ecp)

Parts



Adafruit PyPortal - CircuitPython Powered Internet Display

PyPortal, our easy-to-use IoT device that allows you to create all the things for the “Internet of Things” in minutes. Make custom touch screen interface...

Out of Stock

Out of Stock

1 x USB Cable

USB cable - USB A to Micro-B - 3 foot long

Add to Cart

You can get both of these and a PyPortal stand in AdaBox 011:

AdaBox011 - PyPortal

Reach out beyond your desk - to the stars and beyond - with PyPortal! This ADABOX features a new, easy-to-use IoT device that allows you to customize and create your...

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PyPortal CircuitPython Setup

To use all the amazing features of your PyPortal with CircuitPython, you must first install a number of libraries. This page covers that process.

Adafruit CircuitPython Bundle

Download the Adafruit CircuitPython Library Bundle. You can find the latest release here:

https://adafru.it/ENC

https://adafru.it/ENC

Download the **adafruit-circuitpython-bundle-*.x-mpy-*.zip** bundle zip file where ***.x MATCHES THE VERSION OF CIRCUITPYTHON YOU INSTALLED**, and unzip a folder of the same name. Inside you'll find a **lib** folder. You have two options:

- You can add the **lib** folder to your **CIRCUITPY** drive. This will ensure you have *all the drivers*. But it will take a bunch of space on the 8 MB disk
- Add each library as you need it, this will reduce the space usage but you'll need to put in a little more effort.

At a minimum we recommend the following libraries, in fact we more than recommend. They're basically required. So grab them and install them into **CIRCUITPY/lib** now!

- **adafruit_esp32spi** - This is the library that gives you internet access via the ESP32 using (you guessed it!) SPI transport. You need this for anything Internet
- **adafruit_requests** - This library allows us to perform HTTP requests and get responses back from servers. GET/POST/PUT/PATCH - they're all in here!
- **adafruit_pyportal** - This is our friendly wrapper library that does a lot of our projects, displays graphics and text, fetches data from the internet. Nearly all of our projects depend on it!
- **adafruit_portalbase** - This library is the base library that adafruit_pyportal library is built on top of.
- **adafruit_touchscreen** - a library for reading touches from the resistive touchscreen. Handles all the analog noodling, rotation and calibration for you.
- **adafruit_io** - this library helps connect the PyPortal to our free datalogging and viewing service
- **adafruit_imageload** - an image display helper, required for any graphics!
- **adafruit_display_text** - not surprisingly, it displays text on the screen
- **adafruit_bitmap_font** - we have fancy font support, and its easy to make new fonts. This library reads and parses font files.
- **adafruit_slideshow** - for making image slideshows - handy for quick display of graphics and sound
- **neopixel** - for controlling the onboard neopixel
- **adafruit_adt7410** - library to read the temperature from the on-board Analog Devices ADT7410 precision temperature sensor
- **adafruit_sdcard** - support for reading/writing data from the onboard SD card slot.
- **adafruit_bus_device** - low level support for I2C/SPI
- **adafruit_fakerequests** - This library allows you to create fake HTTP requests by using local files.

Internet Connect!

Once you have CircuitPython setup and libraries installed we can get your board connected to the Internet. Note that access to enterprise level secured WiFi networks is not currently supported, only WiFi networks that require SSID and password.

To get connected, you will need to start by creating a *secrets file*.

What's a secrets file?

We expect people to share tons of projects as they build CircuitPython WiFi widgets. What we want to avoid is people accidentally sharing their passwords or secret tokens and API keys. So, we designed all our examples to use a `secrets.py` file, that is in your **CIRCUITPY** drive, to hold secret/private/custom data. That way you can share your main project without worrying about accidentally sharing private stuff.

Your **secrets.py** file should look like this:

```
# This file is where you keep secret settings, passwords, and tokens!
# If you put them in the code you risk committing that info or sharing it

secrets = {
    'ssid' : 'home ssid',
    'password' : 'my password',
    'timezone' : "America/New_York", # http://worldtimeapi.org/timezones
    'github_token' : 'fawfj23rakjnfawiefa',
    'hackaday_token' : 'h4xx0rs3kret',
    }
```

Inside is a python dictionary named secrets with a line for each entry. Each entry has an entry name (say `'ssid'`) and then a colon to separate it from the entry key `'home ssid'` and finally a comma ,

At a minimum you'll need the `ssid` and `password` for your local WiFi setup. As you make projects you may need more tokens and keys, just add them one line at a time. See for example other tokens such as one for accessing github or the hackaday API. Other non-secret data like your timezone can also go here, just cause it's called secrets doesn't mean you can't have general customization data in there!

For the correct time zone string, look at http://worldtimeapi.org/timezones (https://adafru.it/EcP) and remember that if your city is not listed, look for a city in the same time zone, for example Boston, New York, Philadelphia, Washington DC, and Miami are all on the same time as New York.

Of course, don't share your **secrets.py** - keep that out of GitHub, Discord or other project-sharing sites.

Connect to WiFi

OK now you have your secrets setup - you can connect to the Internet. Lets use the ESP32SPI and the Requests libraries - you'll need to visit the CircuitPython bundle and install (https://adafru.it/ENC):

- **adafruit_bus_device**
- **adafruit_esp32spi**
- **adafruit_requests**
- **neopixel**

Into your `lib` folder. Once that's done, load up the following example using Mu or your favorite editor:

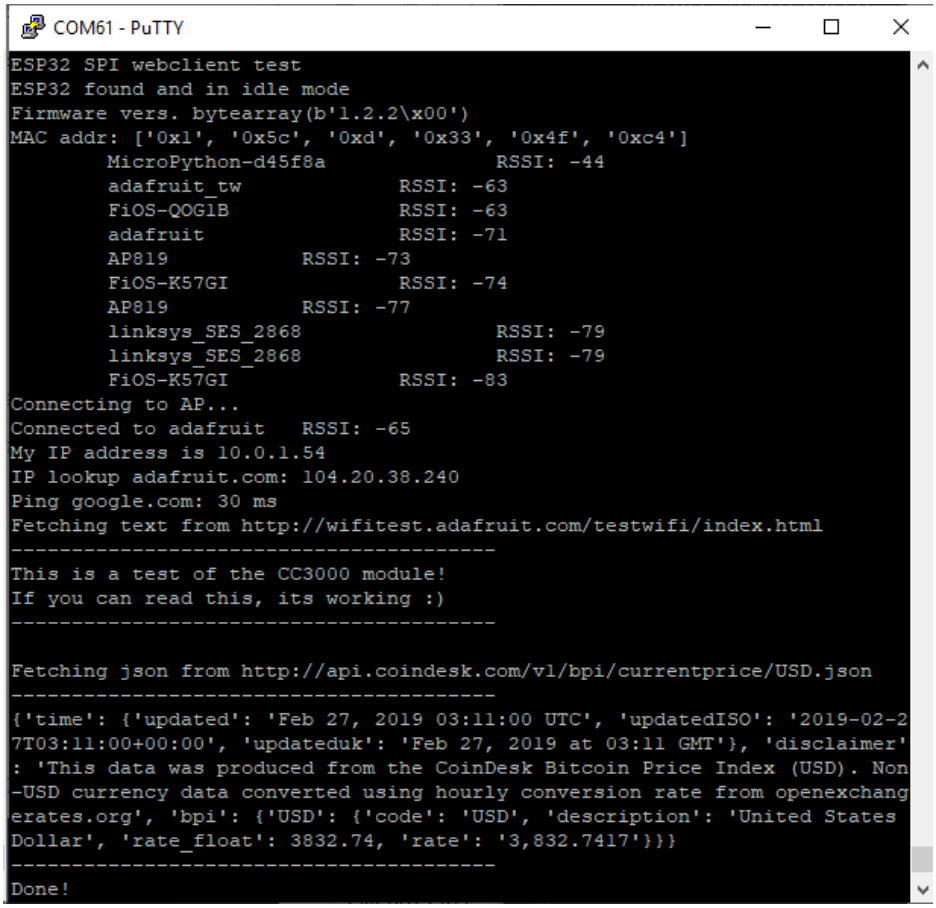
```
# SPDX-FileCopyrightText: 2019 ladyada for Adafruit Industries
# SPDX-License-Identifier: MIT

import board
import busio
from digitalio import DigitalInOut
import adafruit_requests as requests
import adafruit_esp32spi.adafruit_esp32spi_socket as socket
from adafruit_esp32spi import adafruit_esp32spi

# Get wifi details and more from a secrets.py file
try:
    from secrets import secrets
except ImportError:
    print("WiFi secrets are kept in secrets.py, please add them there!")
    raise

print("ESP32 SPI webclient test")

TEXT_URL = "http://wifitest.adafruit.com/testwifi/index.html"
JSON_URL = "http://api.coindesk.com/v1/bpi/currentprice/USD.json"


# If you are using a board with pre-defined ESP32 Pins:
esp32_cs = DigitalInOut(board.ESP_CS)
esp32_ready = DigitalInOut(board.ESP_BUSY)
esp32_reset = DigitalInOut(board.ESP_RESET)

# If you have an AirLift Shield:
# esp32_cs = DigitalInOut(board.D10)
# esp32_ready = DigitalInOut(board.D7)
# esp32_reset = DigitalInOut(board.D5)

# If you have an AirLift Featherwing or ItsyBitsy Airlift:
# esp32_cs = DigitalInOut(board.D13)
# esp32_ready = DigitalInOut(board.D11)
# esp32_reset = DigitalInOut(board.D12)

# If you have an externally connected ESP32:
# NOTE: You may need to change the pins to reflect your wiring
# esp32_cs = DigitalInOut(board.D9)
# esp32_ready = DigitalInOut(board.D10)
# esp32_reset = DigitalInOut(board.D5)

spi = busio.SPI(board.SCK, board.MOSI, board.MISO)
esp = adafruit_esp32spi.ESP_SPIcontrol(spi, esp32_cs, esp32_ready, esp32_reset)

requests.set_socket(socket, esp)

if esp.status == adafruit_esp32spi.WL_IDLE_STATUS:
    print("ESP32 found and in idle mode")
print("Firmware vers.", esp.firmware_version)
print("MAC addr:", [hex(i) for i in esp.MAC_address])

for ap in esp.scan_networks():
    print("\t%s\t\tRSSI: %d" % (str(ap["ssid"], "utf-8"), ap["rssi"]))

print("Connecting to AP...")
while not esp.is_connected:
    try:
        esp.connect_AP(secrets["ssid"], secrets["password"])
    except RuntimeError as e:
        print("could not connect to AP, retrying: ", e)
```

```
        print("could not connect to AP, retrying: ", e)
        continue
print("Connected to", str(esp.ssid, "utf-8"), "\tRSSI:", esp.rssi)
print("My IP address is", esp.pretty_ip(esp.ip_address))
print(
    "IP lookup adafruit.com: %s" % esp.pretty_ip(esp.get_host_by_name("adafruit.com"))
)
print("Ping google.com: %d ms" % esp.ping("google.com"))

# esp._debug = True
print("Fetching text from", TEXT_URL)
r = requests.get(TEXT_URL)
print("-" * 40)
print(r.text)
print("-" * 40)
r.close()

print()
print("Fetching json from", JSON_URL)
r = requests.get(JSON_URL)
print("-" * 40)
print(r.json())
print("-" * 40)
r.close()

print("Done!")
```

And save it to your board, with the name `code.py`.

Don't forget you'll also need to create the `secrets.py` file as seen above, with your WiFi ssid and password

In a serial console, you should see something like the following. For more information about connecting with a serial console, view the guide Connecting to the Serial Console (https://adafru.it/Bec).



In order, the example code...

Initializes the ESP32 over SPI using the SPI port and 3 control pins:

```
esp32_cs = DigitalInOut(board.ESP_CS)
esp32_ready = DigitalInOut(board.ESP_BUSY)
esp32_reset = DigitalInOut(board.ESP_RESET)

spi = busio.SPI(board.SCK, board.MOSI, board.MISO)
esp = adafruit_esp32spi.ESP_SPIcontrol(spi, esp32_cs, esp32_ready, esp32_reset)
```

Tells our `requests` library the type of socket we're using (socket type varies by connectivity type - we'll be using the `adafruit_esp32spi_socket` for this example). We'll also set the interface to an `esp` object. This is a little bit of a hack, but it lets us use `requests` like CPython does.

```
requests.set_socket(socket, esp)
```

Verifies an ESP32 is found, checks the firmware and MAC address

```
if esp.status == adafruit_esp32spi.WL_IDLE_STATUS:
    print("ESP32 found and in idle mode")
print("Firmware vers.", esp.firmware_version)
print("MAC addr:", [hex(i) for i in esp.MAC_address])
```

Performs a scan of all access points it can see and prints out the name and signal strength:

```
for ap in esp.scan_networks():
    print("\t%s\t\tRSSI: %d" % (str(ap['ssid'], 'utf-8'), ap['rssi']))
```

Connects to the AP we've defined here, then prints out the local IP address, attempts to do a domain name lookup and ping google.com to check network connectivity (note sometimes the ping fails or takes a while, this isn't a big deal)

```
print("Connecting to AP...")
while not esp.is_connected:
    try:
        esp.connect_AP(secrets["ssid"], secrets["password"])
    except RuntimeError as e:
        print("could not connect to AP, retrying: ", e)
        continue
print("Connected to", str(esp.ssid, "utf-8"), "\tRSSI:", esp.rssi)
print("My IP address is", esp.pretty_ip(esp.ip_address))
print(
    "IP lookup adafruit.com: %s" % esp.pretty_ip(esp.get_host_by_name("adafruit.com"))
```

OK now we're getting to the really interesting part. With a SAMD51 or other large-RAM (well, over 32 KB) device, we can do a lot of neat tricks. Like for example we can implement an interface a lot like requests (https://adafru.it/E9o) - which makes getting data *really really easy*

To read in all the text from a web URL call `requests.get` - you can pass in `https` URLs for SSL connectivity

```
TEXT_URL = "http://wifitest.adafruit.com/testwifi/index.html"
print("Fetching text from", TEXT_URL)
r = requests.get(TEXT_URL)
print('-'*40)
print(r.text)
print('-'*40)
r.close()
```

Or, if the data is in structured JSON, you can get the json pre-parsed into a Python dictionary that can be easily queried or traversed. (Again, only for nRF52840, M4 and other high-RAM boards)

```
JSON_URL = "http://api.coindesk.com/v1/bpi/currentprice/USD.json"
print("Fetching json from", JSON_URL)
r = requests.get(JSON_URL)
print('-'*40)
print(r.json())
print('-'*40)
r.close()
```

Requests

We've written a requests-like (https://adafru.it/Kpa) library for web interfacing named Adafruit_CircuitPython_Requests (https://adafru.it/FpW). This library allows you to send HTTP/1.1 requests without "crafting" them and provides helpful methods for parsing the response from the server.

```
# SPDX-FileCopyrightText: 2021 ladyada for Adafruit Industries
# SPDX-License-Identifier: MIT

# adafruit_requests usage with an esp32spi_socket
import board
import busio
```

```
from digitalio import DigitalInOut
import adafruit_esp32spi.adafruit_esp32spi_socket as socket
from adafruit_esp32spi import adafruit_esp32spi
import adafruit_requests as requests

# Add a secrets.py to your filesystem that has a dictionary called secrets with "ssid" and
# "password" keys with your WiFi credentials. DO NOT share that file or commit it into Git or other
# source control.
# pylint: disable=no-name-in-module,wrong-import-order
try:
    from secrets import secrets
except ImportError:
    print("WiFi secrets are kept in secrets.py, please add them there!")
    raise

# If you are using a board with pre-defined ESP32 Pins:
esp32_cs = DigitalInOut(board.ESP_CS)
esp32_ready = DigitalInOut(board.ESP_BUSY)
esp32_reset = DigitalInOut(board.ESP_RESET)

# If you have an externally connected ESP32:
# esp32_cs = DigitalInOut(board.D9)
# esp32_ready = DigitalInOut(board.D10)
# esp32_reset = DigitalInOut(board.D5)

spi = busio.SPI(board.SCK, board.MOSI, board.MISO)
esp = adafruit_esp32spi.ESP_SPIcontrol(spi, esp32_cs, esp32_ready, esp32_reset)

print("Connecting to AP...")
while not esp.is_connected:
    try:
        esp.connect_AP(secrets["ssid"], secrets["password"])
    except RuntimeError as e:
        print("could not connect to AP, retrying: ", e)
        continue
print("Connected to", str(esp.ssid, "utf-8"), "\tRSSI:", esp.rssi)

# Initialize a requests object with a socket and esp32spi interface
socket.set_interface(esp)
requests.set_socket(socket, esp)

TEXT_URL = "http://wifitest.adafruit.com/testwifi/index.html"
JSON_GET_URL = "http://httpbin.org/get"
JSON_POST_URL = "http://httpbin.org/post"

print("Fetching text from %s" % TEXT_URL)
response = requests.get(TEXT_URL)
print("-" * 40)

print("Text Response: ", response.text)
print("-" * 40)
response.close()

print("Fetching JSON data from %s" % JSON_GET_URL)
response = requests.get(JSON_GET_URL)
print("-" * 40)

print("JSON Response: ", response.json())
print("-" * 40)
response.close()

data = "31F"
print("POSTing data to {0}: {1}".format(JSON_POST_URL, data))
```

```
response = requests.post(JSON_POST_URL, data=data)
print("-" * 40)

json_resp = response.json()
# Parse out the 'data' key from json_resp dict.
print("Data received from server:", json_resp["data"])
print("-" * 40)
response.close()

json_data = {"Date": "July 25, 2019"}
print("POSTing data to {0}: {1}".format(JSON_POST_URL, json_data))
response = requests.post(JSON_POST_URL, json=json_data)
print("-" * 40)

json_resp = response.json()
# Parse out the 'json' key from json_resp dict.
print("JSON Data received from server:", json_resp["json"])
print("-" * 40)
response.close()
```

The code first sets up the ESP32SPI interface. Then, it initializes a `request` object using an ESP32 `socket` and the `esp` object.

```
import board
import busio
from digitalio import DigitalInOut
import adafruit_esp32spi.adafruit_esp32spi_socket as socket
from adafruit_esp32spi import adafruit_esp32spi
import adafruit_requests as requests

# If you are using a board with pre-defined ESP32 Pins:
esp32_cs = DigitalInOut(board.ESP_CS)
esp32_ready = DigitalInOut(board.ESP_BUSY)
esp32_reset = DigitalInOut(board.ESP_RESET)

# If you have an externally connected ESP32:
# esp32_cs = DigitalInOut(board.D9)
# esp32_ready = DigitalInOut(board.D10)
# esp32_reset = DigitalInOut(board.D5)

spi = busio.SPI(board.SCK, board.MOSI, board.MISO)
esp = adafruit_esp32spi.ESP_SPIcontrol(spi, esp32_cs, esp32_ready, esp32_reset)

print("Connecting to AP...")
while not esp.is_connected:
    try:
        esp.connect_AP(b'MY_SSID_NAME', b'MY_SSID_PASSWORD')
    except RuntimeError as e:
        print("could not connect to AP, retrying: ",e)
        continue
print("Connected to", str(esp.ssid, 'utf-8'), "\tRSSI:", esp.rssi)

# Initialize a requests object with a socket and esp32spi interface
requests.set_socket(socket, esp)
```

HTTP GET with Requests

The code makes a HTTP GET request to Adafruit's WiFi testing website - http://wifitest.adafruit.com/testwifi/index.html (https://adafru.it/FpZ).

To do this, we'll pass the URL into `requests.get()`. We're also going to save the response *from* the server into a variable named `response`.

While we requested data from the server, we'd what the server responded with. Since we already saved the server's `response`, we can read it back. Luckily for us, **requests automatically decodes the server's response into human-readable text,** you can read it back by calling `response.text`.

Lastly, we'll perform a bit of cleanup by calling `response.close()`. This closes, deletes, and collect's the response's data.

```
print("Fetching text from %s"%TEXT_URL)
response = requests.get(TEXT_URL)
print('-'*40)

print("Text Response: ", response.text)
print('-'*40)
response.close()
```

While some servers respond with text, some respond with json-formatted data consisting of attribute–value pairs.

CircuitPython_Requests can convert a JSON-formatted response from a server into a CPython `dict.` object.

We can also fetch and parse **json** data. We'll send a HTTP get to a url we know returns a json-formatted response (instead of text data).

Then, the code calls `response.json()` to convert the response to a CPython `dict`.

```
print("Fetching JSON data from %s"%JSON_GET_URL)
response = requests.get(JSON_GET_URL)
print('-'*40)

print("JSON Response: ", response.json())
print('-'*40)
response.close()
```

HTTP POST with Requests

Requests can also **POST data to a server by calling the `requests.post` method, passing it a `data` value.**

```
data = '31F'
print("POSTing data to {0}: {1}".format(JSON_POST_URL, data))
response = requests.post(JSON_POST_URL, data=data)
print('-'*40)

json_resp = response.json()
# Parse out the 'data' key from json_resp dict.
print("Data received from server:", json_resp['data'])
print('-'*40)
response.close()
```

You can also post json-formatted data to a server by passing `json_data` into the `requests.post` method.

```
    json_data = {"Date" : "July 25, 2019"}
print("POSTing data to {0}: {1}".format(JSON_POST_URL, json_data))
response = requests.post(JSON_POST_URL, json=json_data)
print('-'*40)

json_resp = response.json()
# Parse out the 'json' key from json_resp dict.
print("JSON Data received from server:", json_resp['json'])
print('-'*40)
response.close()
```

Advanced Requests Usage

Want to send custom HTTP headers, parse the response as raw bytes, or handle a response's http status code in your CircuitPython code?

We've written an example to show advanced usage of the requests module below.

```
# SPDX-FileCopyrightText: 2021 ladyada for Adafruit Industries
# SPDX-License-Identifier: MIT

import board
import busio
from digitalio import DigitalInOut
import adafruit_esp32spi.adafruit_esp32spi_socket as socket
from adafruit_esp32spi import adafruit_esp32spi
import adafruit_requests as requests

# Add a secrets.py to your filesystem that has a dictionary called secrets with "ssid" and
# "password" keys with your WiFi credentials. DO NOT share that file or commit it into Git or other
# source control.
# pylint: disable=no-name-in-module,wrong-import-order
try:
    from secrets import secrets
except ImportError:
    print("WiFi secrets are kept in secrets.py, please add them there!")
    raise

# If you are using a board with pre-defined ESP32 Pins:
esp32_cs = DigitalInOut(board.ESP_CS)
esp32_ready = DigitalInOut(board.ESP_BUSY)
esp32_reset = DigitalInOut(board.ESP_RESET)

# If you have an externally connected ESP32:
# esp32_cs = DigitalInOut(board.D9)
# esp32_ready = DigitalInOut(board.D10)
# esp32_reset = DigitalInOut(board.D5)

spi = busio.SPI(board.SCK, board.MOSI, board.MISO)
esp = adafruit_esp32spi.ESP_SPIcontrol(spi, esp32_cs, esp32_ready, esp32_reset)

print("Connecting to AP...")
while not esp.is_connected:
    try:
        esp.connect_AP(secrets["ssid"], secrets["password"])
    except RuntimeError as e:
        print("could not connect to AP, retrying: ", e)
        continue
print("Connected to", str(esp.ssid, "utf-8"), "\tRSSI:", esp.rssi)

# Initialize a requests object with a socket and esp32spi interface
```

```
# Initialize a requests object with a socket and esp32spi interface
socket.set_interface(esp)
requests.set_socket(socket, esp)

JSON_GET_URL = "http://httpbin.org/get"

# Define a custom header as a dict.
headers = {"user-agent": "blinka/1.0.0"}

print("Fetching JSON data from %s..." % JSON_GET_URL)
response = requests.get(JSON_GET_URL, headers=headers)
print("-" * 60)

json_data = response.json()
headers = json_data["headers"]
print("Response's Custom User-Agent Header: {0}".format(headers["User-Agent"]))
print("-" * 60)

# Read Response's HTTP status code
print("Response HTTP Status Code: ", response.status_code)
print("-" * 60)

# Close, delete and collect the response data
response.close()
```

WiFi Manager

That simpletest example works but it's a little finicky - you need to constantly check WiFi status and have many loops to manage connections and disconnections. For more advanced uses, we recommend using the WiFiManager object. It will wrap the connection/status/requests loop for you - reconnecting if WiFi drops, resetting the ESP32 if it gets into a bad state, etc.

Here's a more advanced example that shows the WiFi manager and also how to POST data with some extra headers:

```
# SPDX-FileCopyrightText: 2019 ladyada for Adafruit Industries
# SPDX-License-Identifier: MIT

import time
import board
import busio
from digitalio import DigitalInOut
import neopixel
from adafruit_esp32spi import adafruit_esp32spi
from adafruit_esp32spi import adafruit_esp32spi_wifimanager

print("ESP32 SPI webclient test")

# Get wifi details and more from a secrets.py file
try:
    from secrets import secrets
except ImportError:
    print("WiFi secrets are kept in secrets.py, please add them there!")
    raise

# If you are using a board with pre-defined ESP32 Pins:
esp32_cs = DigitalInOut(board.ESP_CS)
esp32_ready = DigitalInOut(board.ESP_BUSY)
esp32_reset = DigitalInOut(board.ESP_RESET)

# If you have an externally connected ESP32:
```

```
# esp32_cs = DigitalInOut(board.D9)
# esp32_ready = DigitalInOut(board.D10)
# esp32_reset = DigitalInOut(board.D5)

spi = busio.SPI(board.SCK, board.MOSI, board.MISO)
esp = adafruit_esp32spi.ESP_SPIcontrol(spi, esp32_cs, esp32_ready, esp32_reset)
"""Use below for Most Boards"""
status_light = neopixel.NeoPixel(
    board.NEOPIXEL, 1, brightness=0.2
)  # Uncomment for Most Boards
"""Uncomment below for ItsyBitsy M4"""
# status_light = dotstar.DotStar(board.APA102_SCK, board.APA102_MOSI, 1, brightness=0.2)
# Uncomment below for an externally defined RGB LED
# import adafruit_rgbled
# from adafruit_esp32spi import PWMOut
# RED_LED = PWMOut.PWMOut(esp, 26)
# GREEN_LED = PWMOut.PWMOut(esp, 27)
# BLUE_LED = PWMOut.PWMOut(esp, 25)
# status_light = adafruit_rgbled.RGBLED(RED_LED, BLUE_LED, GREEN_LED)
wifi = adafruit_esp32spi_wifimanager.ESPSPI_WiFiManager(esp, secrets, status_light)

counter = 0

while True:
    try:
        print("Posting data...", end="")
        data = counter
        feed = "test"
        payload = {"value": data}
        response = wifi.post(
            "https://io.adafruit.com/api/v2/"
            + secrets["aio_username"]
            + "/feeds/"
            + feed
            + "/data",
            json=payload,
            headers={"X-AIO-KEY": secrets["aio_key"]},
        )
        print(response.json())
        response.close()
        counter = counter + 1
        print("OK")
    except (ValueError, RuntimeError) as e:
        print("Failed to get data, retrying\n", e)
        wifi.reset()
        continue
    response = None
    time.sleep(15)
```

You'll note here we use a secrets.py file to manage our SSID info. The wifimanager is given the ESP32 object, secrets and a neopixel for status indication.

Note, you'll need to add a some additional information to your secrets file so that the code can query the Adafruit IO API:

- `aio_username`
- `aio_key`

You can go to your adafruit.io View AIO Key link to get those two values and add them to the secrets file, which will now look something like this:

```
# This file is where you keep secret settings, passwords, and tokens!
# If you put them in the code you risk committing that info or sharing it

secrets = {
    'ssid' : '_your_ssid_',
    'password' : '_your_wifi_password_',
    'timezone' : "America/Los_Angeles", # http://worldtimeapi.org/timezones
    'aio_username' : '_your_aio_username_',
    'aio_key' : '_your_aio_key_',
    }
```

Next, **set up an Adafruit IO feed named** `test`

- If you do not know how to set up a feed, follow this page and come back when you've set up a feed named `test`. (https://adafru.it/f5k)

We can then have a simple loop for posting data to Adafruit IO without having to deal with connecting or initializing the hardware!

Take a look at your **test** feed on Adafruit.io and you'll see the value increase each time the CircuitPython board posts data to it!

Hue Bridge Setup

CircuitPython Library Installation

First make sure you are running the latest version of Adafruit CircuitPython (https://adafru.it/Egk) for your board.

Next you'll need to install the necessary libraries to use the hardware--carefully follow the steps to find and install these libraries from Adafruit's CircuitPython library bundle (https://adafru.it/zdx) matching your version of CircuitPython. PyPortal requires at least CircuitPython version 4.0.0.

Before continuing make sure your board's **lib** folder has the following files and folders copied over.

- **adafruit_hue**
- **simpleio**
- **adafruit_bitmap_font**
- **adafruit_bus_device**
- **adafruit_button**
- **adafruit_display_shapes**
- **adafruit_display_text**
- **adafruit_esp32spi**
- **adafruit_touchscreen**
- **neopixel**

Add CircuitPython Code and Project Assets

In the embedded code element below, click on the **Download: Project Zip** link, and save the .zip archive file to your computer.

Then, **uncompress the .zip file**, it will unpack to a folder named **PyPortal_Philips_Hue_Controller**.

Copy the contents of the **PyPortal_Philips_Hue_Controller** directory to your PyPortal's **CIRCUITPY** drive. Your CircuitPython code file needs to be named **code.py** to run on startup.

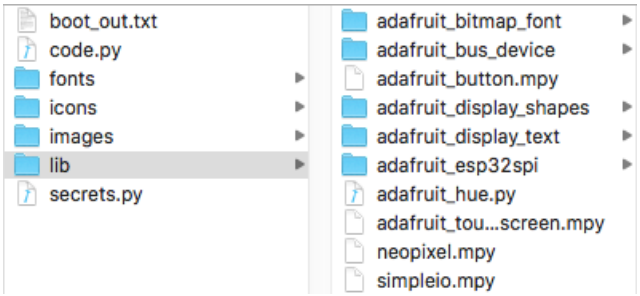
```
"""
PyPortal Philips Hue Lighting Controller

Brent Rubell for Adafruit Industries, 2019
"""
import board
import displayio
from adafruit_bitmap_font import bitmap_font
from adafruit_button import Button
import adafruit_touchscreen
from digitalio import DigitalInOut
import busio
import neopixel
from adafruit_esp32spi import adafruit_esp32spi
from adafruit_esp32spi import adafruit_esp32spi_wifimanager

# Import Philips Hue Bridge
from adafruit_hue import Bridge

# Get wifi details and more from a secrets.py file
try:
    from secrets import secrets
except ImportError:
```

```
except ImportError:
    print("WiFi secrets are kept in secrets.py, please add them there!")
    raise

# ESP32 SPI
esp32_cs = DigitalInOut(board.ESP_CS)
esp32_ready = DigitalInOut(board.ESP_BUSY)
esp32_reset = DigitalInOut(board.ESP_RESET)
spi = busio.SPI(board.SCK, board.MOSI, board.MISO)
esp = adafruit_esp32spi.ESP_SPIcontrol(spi, esp32_cs, esp32_ready, esp32_reset)
status_light = neopixel.NeoPixel(board.NEOPIXEL, 1, brightness=0.2)
wifi = adafruit_esp32spi_wifimanager.ESPSPI_WiFiManager(esp, secrets, status_light)

# Attempt to load bridge username and IP address from secrets.py
try:
    username = secrets['hue_username']
    bridge_ip = secrets['bridge_ip']
    my_bridge = Bridge(wifi, bridge_ip, username)
except:
    # Perform first-time bridge setup
    my_bridge = Bridge(wifi)
    print('Finding bridge address...')
    ip = my_bridge.discover_bridge()
    print('Attempting to register username, press the link button on your Hue Bridge now!')
    username = my_bridge.register_username()
    print('ADD THESE VALUES TO SECRETS.PY: \
                            \n\t"bridge_ip":"{0}", \
                            \n\t"hue_username":"{1}"'.format(ip, username))
    raise

# These pins are used as both analog and digital! XL, XR and YU must be analog
# and digital capable. YD just need to be digital
ts = adafruit_touchscreen.Touchscreen(board.TOUCH_XL, board.TOUCH_XR,
                                      board.TOUCH_YD, board.TOUCH_YU,
                                      calibration=((5200, 59000), (5800, 57000)),
                                      size=(320, 240))


# Make the display context
button_group = displayio.Group(max_size=20)
board.DISPLAY.show(button_group)
# preload the font
print('loading font...')
font = bitmap_font.load_font("/fonts/Arial-12.bdf")
glyphs = b'0123456789abcdefghijklmnopqrstuvwxyzABCDEFGHIJKLMNOPQRSTUVWXYZ-,.: '
font.load_glyphs(glyphs)
# button properties
BUTTON_WIDTH = 60
BUTTON_HEIGHT = 60
buttons = []

print('loading colors...')
# color conversions (RGB to Philips Hue-compatible HSB)
red = my_bridge.rgb_to_hsb([255, 0, 0])
white = my_bridge.rgb_to_hsb([255, 255, 255])
orange = my_bridge.rgb_to_hsb([255, 165, 0])
yellow = my_bridge.rgb_to_hsb([255, 255, 0])
green = my_bridge.rgb_to_hsb([0, 255, 0])
blue = my_bridge.rgb_to_hsb([0, 0, 255])
purple = my_bridge.rgb_to_hsb([128, 0, 128])
pink = my_bridge.rgb_to_hsb([255, 192, 203])

hue_hsb = {'red': red, 'white': white, 'orange': orange,
           'yellow': yellow, 'green': green, 'blue': blue
```

```
            'yellow': yellow, 'green': green, 'blue': blue,
           'purple': purple, 'pink': pink}

print('loading buttons...')
# button fill colors
button_colors = {'red':0xFF0000, 'white':0xFFFFFF,
                 'orange':0xFF9900, 'yellow':0xFFFF00,
                 'green':0x00FF00, 'blue':0x0000FF,
                 'purple':0x9900FF, 'pink': 0xFF00FF}
# list of color buttons and their properties
color_btn = [
    {'name':'red', 'pos':(15, 80), 'color':button_colors['red']},
    {'name':'white', 'pos':(85, 80), 'color':button_colors['white']},
    {'name':'orange', 'pos':(155, 80), 'color':button_colors['orange']},
    {'name':'yellow', 'pos':(225, 80), 'color':button_colors['yellow']},
    {'name':'pink', 'pos':(15, 155), 'color':button_colors['pink']},
    {'name':'green', 'pos':(85, 155), 'color':button_colors['green']},
    {'name':'blue', 'pos':(155, 155), 'color':button_colors['blue']},
    {'name':'purple', 'pos':(225, 155), 'color':button_colors['purple']}
]

# generate color buttons from color_btn list
for i in color_btn:
    button = Button(x=i['pos'][0], y=i['pos'][1],
                    width=BUTTON_WIDTH, height=BUTTON_HEIGHT, name=i['name'],
                    fill_color=i['color'], style=Button.ROUNDRECT)
    buttons.append(button)

# light property buttons and their properties
prop_btn = [
    {'name':'onoff', 'pos':(15, 15), 'label':'on/off'},
    {'name':'up', 'pos':(75, 15), 'label':'+'},
    {'name':'down', 'pos':(135, 15), 'label':'-'},
    {'name':'room', 'pos':(195, 15), 'label':'room'},
    {'name':'lamp', 'pos':(255, 15), 'label':'lamp'}
]

# generate property buttons from prop_btn list
for i in prop_btn:
    button = Button(name=i['name'], x=i['pos'][0], y=i['pos'][1],
                    width=55, height=40, label=i['label'],
                    label_font=font, style=Button.SHADOWROUNDRECT)
    buttons.append(button)

# add buttons to the group
for b in buttons:
    button_group.append(b.group)

# Hue Light/Group Identifiers
hue_lights={'lamp': 1, 'livingroom': 2}
hue_selector = hue_lights['lamp']

# Default to 25% brightness
current_brightness = 25

while True:
    touch = ts.touch_point
    if touch:
        for i, button in enumerate(buttons):
            if button.contains(touch):
                button.selected = True
                if button.name == 'room':
                    hue_selector = hue_lights['livingroom']
                    print('Switching to ', hue_selector)
```

```
            print('Switching to ', hue_selector)
        elif button.name == 'lamp':
            hue_selector = hue_lights['lamp']
            print('Switching to ', hue_selector)
        elif button.name == 'onoff':
            print('Toggling {0}...'.format(hue_selector))
            my_bridge.toggle_light(int(hue_selector))
        elif button.name == 'up':
            current_brightness += 25
            print('Setting {0} brightness to {1}'.format(hue_selector, current_brightness))
            my_bridge.set_light(int(hue_selector), bri=current_brightness)
        elif button.name == 'down':
            current_brightness -= 25
            print('Setting {0} brightness to {1}'.format(hue_selector, current_brightness))
            my_bridge.set_light(int(hue_selector), bri=current_brightness)
        else:
            print('Setting {0} color to {1}'.format(hue_selector, button.name))
            my_bridge.set_light(light_id=int(hue_selector),
                                hue=int(hue_hsb[button.name][0]),
                                sat=int(hue_hsb[button.name][1]),
                                bri=int(hue_hsb[button.name][2]))
        button.selected = False
    else:
        button.selected = False
```

This is what the final contents of the **CIRCUITPY** drive will look like:



Bridge Setup

The Hue system is built around the Hue Bridge. To communicate with the bridge, **you'll need to register a unique username (stored on the bridge) for the PyPortal**. you'll also need the Bridge's IP address to communicate with it.

We've built the CircuitPython Hue library **(https://adafru.it/Ezw) to automate the process of discovering and registering a username with the bridge** - but, you'll still need to add these values to the **secrets.py** file. **This is a one-time setup and does not need to be repeated** .

This guide requires you to edit and interact with CircuitPython code. **Mu** is a simple code editor that works with the Adafruit CircuitPython boards. It's written in Python and works on Windows, MacOS, Linux and Raspberry Pi. The serial console is built right in so you get immediate feedback from your board's serial output!

Before proceeding, click the button below to install the Mu Editor. There are versions for PC, mac, and Linux.

https://adafru.it/ANO

https://adafru.it/ANO

Secrets File Setup

First, use Mu to open up a **secrets.py** file on your **CIRCUITPY** drive.

Edit the file to enter your local WiFi credentials. For help getting connected to the Internet using it, follow this guide and come back to this page when you've successfully connected to the Internet (https://adafru.it/Eao).

You can then close **secrets.py**, saving the updated file onto the PyPortal.

Next, open the Mu editor and open the file **code.py**.

For this next step, you will need to connect to the serial console using Mu (https://adafru.it/ANO) or a different terminal program.

- Not sure how to connect to your PyPortal's REPL? Read this page here and come back to the guide once you're connected. (https://adafru.it/Bec)

Once connected to the PyPortal, the REPL will display that the code is searching for the bridge address using the WiFi credentials entered previously into **secrets.py**:

```
code.py output:
Finding bridge address...
```

If the bridge address was found, the code will attempt to register a random, unique username with the bridge:

```
Attempting to register username, press the link button on your Hue Bridge now!
```

- 

When it prints this, you have exactly **120 seconds** to **press the link button on top of the Hue Bridge**.

- We've found that **you may need to press this button more than once** during this period to ensure a username is successfully generated.

Once the button on top of the bridge is pressed, the code will print the bridge IP address and username to the REPL:

```
ADD THESE VALUES TO SECRETS.PY:
        "bridge_ip":"192.160.0.00",
        "hue_username":"UpsdCULBXvOtWXaqgeTpdAp26Np9hu43x5XjkaLX"
```

Modify the secrets.py file again by **adding** `bridge_ip` **and** `hue_username` **from the REPL output** and **save the file**. Your **secrets.py** file should look similar to the sample below.

```
secrets = {
    'ssid' : 'home ssid',
    'password' : 'my password',
    'timezone' : "America/New_York", # http://worldtimeapi.org/timezones
    'bridge_ip' : '192.160.0.00',
    'hue_username': 'UpsdCULBXvOtWXaqgeTpdAp26Np9hu43x5XjkaLX'
    }
```

Issues?

hue_username displaying as 'None'?

If the code is returning `None` for the `hue_username`:

`ADD THESE VALUES TO SECRETS.PY`

`"bridge_ip":"192.160.0.00",`

`"hue_username":"None"`

Make sure that you're pressing all the way down on the button. Try tapping it multiple times during the username generation process to ensure it returns a username back to the PyPortal.

bridge_ip displaying as 'None'?

If the code is returning `None` for the `bridge_ip`:

`ADD THESE VALUES TO SECRETS.PY`

`"bridge_ip":"None",`

`"hue_username":"UpsdCULBXvOtWXaqgeTpdAp26Np9hu43x5XjkaLX"`

Ensure the bridge is connected to the same wireless network as the PyPortal.

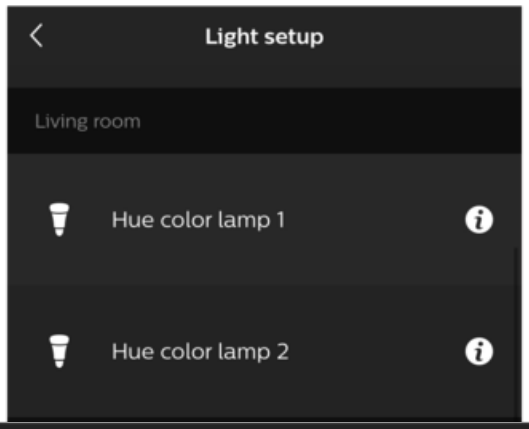
Done

Setting up the PyPortal with the bridge is finished! You do not need to repeat this process again unless you misplace the randomly generated username string.

Code Usage

Hue Lights Setup

Before your can control our lights with the PyPortal, we'll need to set which lights we'd like to control within the code (**code.py**).

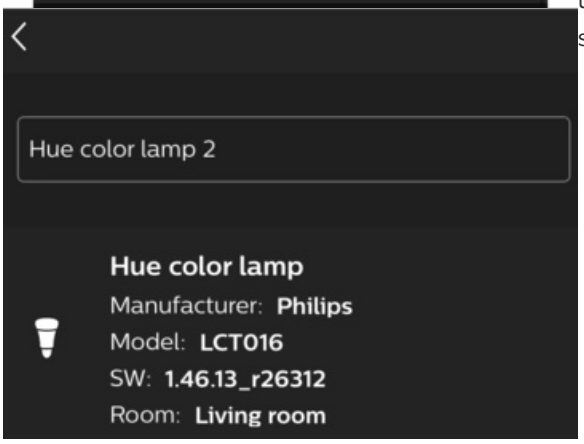
- 

Open the Philips Hue application on your phone/tablet.

Navigate to **Settings->Light Setup**

The number next to the light is the light identifier. You'll be using this value in the code to refer to the light which you're setting.

- **Tapping** the *i* next to the light's name will bring up more information about it - like which room/group it's assigned to and the full name.

- 

Next, you'll **modify the following lines of code to correspond with the light identifier you're controlling.**

- **If you're new to creating and editing CircuitPython code:** Read through this page and come back to this guide when you're ready. **(https://adafru.it/BIN)**

For example, if you are setting up a lamp an identifier of 3 and a living room light with an identifier of 1, edit the following line in **code.py** from:

```
hue_lights={'lamp': 1, 'livingroom': 2}
```

to

```
hue_lights={'lamp': 3, 'livingroom': 1}
```

Code Usage

From the Mu Editor, **click the Serial button** to open the REPL. You should see the REPL display the code's status as it loads the interface.

Select a light by tapping the name of the light you'd like to control. The code will default to the first light specified within the `hue_lights` list.

Tap the on/off button to toggle the power of the light you selected.

- **Buttons invert their color while they make a request** to the Hue Bridge. **Once the request is complete, the button changes back to its original color.**
- **If you're having issues with your light not responding:** Scroll down to the *Diagnosing Errors* section below.

Diagnosing Errors

Tapping a color button will set the light to the button's fill color.

- We used the Hue library's `rgb_to_hsv` method to set different colors for the buttons. For more information about this method and how the code works, navigate to the *Code Walkthrough* page for this guide.

Code Walkthrough

Importing Libraries

```
import board
import displayio
from adafruit_bitmap_font import bitmap_font
from adafruit_button import Button
import adafruit_touchscreen
from digitalio import DigitalInOut
import busio
import neopixel
from adafruit_esp32spi import adafruit_esp32spi
from adafruit_esp32spi import adafruit_esp32spi_wifimanager

# Import Philips Hue Bridge
from adafruit_hue import Bridge
```

The code first imports all of the libraries required to run the Smart Lighting Controller.

Note that the code imports a special `adafruit_hue` library. To communicate with the Hue Bridge, we wrote a CircuitPython helper module called `CircuitPython_Hue` (https://adafru.it/Ezw). This module makes HTTP requests (or, "talks") to the Hue Bridge's IP address in order to interact with the bulbs.

- For more information about how HTTP works, check out our All The Internet of Things guide on this topic here (https://adafru.it/Evy).

Configuring the PyPortal

```
# Get wifi details and more from a secrets.py file
try:
    from secrets import secrets
except ImportError:
    print("WiFi secrets are kept in secrets.py, please add them there!")
    raise

# ESP32 SPI
esp32_cs = DigitalInOut(board.ESP_CS)
esp32_ready = DigitalInOut(board.ESP_BUSY)
esp32_reset = DigitalInOut(board.ESP_RESET)
spi = busio.SPI(board.SCK, board.MOSI, board.MISO)
esp = adafruit_esp32spi.ESP_SPIcontrol(spi, esp32_cs, esp32_ready, esp32_reset)
status_light = neopixel.NeoPixel(board.NEOPIXEL, 1, brightness=0.2)
wifi = adafruit_esp32spi_wifimanager.ESPSPI_WiFiManager(esp, secrets, status_light)
```

The next chunk of code grabs information from a **secrets.py** file including wifi configuration. Then, it sets up the ESP32's SPI connections for use with the PyPortal. The `wifi` object is set up here too - it's used later in the code to communicate with the bridge.

Configuring the Hue helper module

```
# Attempt to load bridge username and IP address from secrets.py
try:
    username = secrets['hue_username']
    bridge_ip = secrets['bridge_ip']
    my_bridge = Bridge(wifi, bridge_ip, username)
except:
    # Perform first-time bridge setup
    my_bridge = Bridge(wifi)
    print('Finding bridge address...')
    ip = my_bridge.discover_bridge()
    print('Attempting to register username, press the link button on your Hue Bridge now!')
    username = my_bridge.register_username()
    print('ADD THESE VALUES TO SECRETS.PY: \
                            \n\t"bridge_ip":"{0}", \
                            \n\t"hue_username":"{1}"'.format(ip, username))
    raise
```

The entire Hue system is built around the Hue Bridge. To communicate with the bridge, you'll need to register a unique username (stored on the bridge) for the PyPortal. you'll also need the Bridge's IP address to communicate with it. There's a bit of a HTTP request/reply "dance" associated with this process and it's tricky.

The CircuitPython Hue library automates the process of discovering and registering a username with the bridge - but, you'll still need to add these values to the **secrets.py** file.

- For more information about the bridge setup - read the *Hue Bridge Setup* page of this guide (https://adafru.it/Ezx).

Hue Color Setup

```
print('loading colors...')
# color conversions (RGB to Philips Hue-compatible HSB)
red = my_bridge.rgb_to_hsb([255, 0, 0])
white = my_bridge.rgb_to_hsb([255, 255, 255])
orange = my_bridge.rgb_to_hsb([255, 165, 0])
yellow = my_bridge.rgb_to_hsb([255, 255, 0])
green = my_bridge.rgb_to_hsb([0, 255, 0])
blue = my_bridge.rgb_to_hsb([0, 0, 255])
purple = my_bridge.rgb_to_hsb([128, 0, 128])
pink = my_bridge.rgb_to_hsb([255, 192, 203])

hue_hsb = {'red': red, 'white': white, 'orange': orange,
           'yellow': yellow, 'green': green, 'blue': blue,
           'purple': purple, 'pink': pink}
```

When you want to modify the light's state from within your code, you'd use the `set_light` method in `CircuitPython_Hue`. This method mirrors Philips' *set light state* API endpoint (https://adafru.it/Ezy) - but it has some non user-friendly features.

The **Hue API uses HSB** (**H**ue, **S**aturation, **B**rightness) instead of **RGB** (**r**ed, **g**reen, **b**lue) values. It also does not take in brightness percentages, or hue degrees. Instead, it takes in scaled integer values which directly relate to to the brightness percentage or hue degrees.

To make this simpler - we added a **`rgb_to_hsb`** method within the Hue helper module. Passing a list of RGB values into this method will return a scaled HSB list.

- **If you wish to use RGB colors with your PyPortal Hue Controller - use this method before calling** `set_light` to convert and scale your colors.

Our code predefines a few colors (red, white, orange, yellow, green, blue, purple, pink) by converting them *from* RGB values *to* scaled HSB values. using **`rgb_to_hsb`**.

Button Setup

```
# Make the display context
button_group = displayio.Group(max_size=20)
board.DISPLAY.show(button_group)
# preload the font
print('loading font...')
font = bitmap_font.load_font("/fonts/Arial-12.bdf")
glyphs = b'0123456789abcdefghijklmnopqrstuvwxyzABCDEFGHIJKLMNOPQRSTUVWXYZ-,.: '
font.load_glyphs(glyphs)
# button properties
BUTTON_WIDTH = 60
BUTTON_HEIGHT = 60
buttons = []
```

Before the code can create buttons, it needs to create a `displayio` group to hold them. Here - the code selects a font, preloads it with glyphs, and sets button properties for `BUTTON_WIDTH` and `BUTTON_HEIGHT`.

Button Generation

```
# button fill colors
button_colors = {'red':0xFF0000, 'white':0xFFFFFF,
                 'orange':0xFF9900, 'yellow':0xFFFF00,
                 'green':0x00FF00, 'blue':0x0000FF,
                 'purple':0x9900FF, 'pink': 0xFF00FF}
# list of color buttons and their properties
color_btn = [
    {'name':'red', 'pos':(15, 80), 'color':button_colors['red']},
    {'name':'white', 'pos':(85, 80), 'color':button_colors['white']},
    {'name':'orange', 'pos':(155, 80), 'color':button_colors['orange']},
    {'name':'yellow', 'pos':(225, 80), 'color':button_colors['yellow']},
    {'name':'pink', 'pos':(15, 155), 'color':button_colors['pink']},
    {'name':'green', 'pos':(85, 155), 'color':button_colors['green']},
    {'name':'blue', 'pos':(155, 155), 'color':button_colors['blue']},
    {'name':'purple', 'pos':(225, 155), 'color':button_colors['purple']}
]

# generate color buttons from color_btn list
for i in color_btn:
    button = Button(x=i['pos'][0], y=i['pos'][1],
                    width=BUTTON_WIDTH, height=BUTTON_HEIGHT, name=i['name'],
                    fill_color=i['color'], style=Button.ROUNDRECT)
    buttons.append(button)

# light property buttons and their properties
prop_btn = [
    {'name':'onoff', 'pos':(15, 15), 'label':'on/off'},
    {'name':'up', 'pos':(75, 15), 'label':'+'},
    {'name':'down', 'pos':(135, 15), 'label':'-'},
    {'name':'room', 'pos':(195, 15), 'label':'room'},
    {'name':'lamp', 'pos':(255, 15), 'label':'lamp'}
]

# generate property buttons from prop_btn list
for i in prop_btn:
    button = Button(name=i['name'], x=i['pos'][0], y=i['pos'][1],
                    width=55, height=40, label=i['label'],
                    label_font=font, style=Button.SHADOWROUNDRECT)
    buttons.append(button)

# add buttons to the group
for b in buttons:
    button_group.append(b.group)
```

The next chunk of code creates buttons for the light colors and properties.

First, a list of dictionary items is created corresponding to button properties. The `color_btn` list contains information for the button such as the button's name, position on the display, and hex color value. The `prop_btn` list contains the button's name, position and text label.

Then, buttons are generated from the list and appended to a `button` list. When all the buttons have been added to `button` list, they are appended to the displayio `button_group` one-by-one.

Light Setup

```
# Hue Light/Group Identifiers
hue_lights={'lamp': 1, 'livingroom': 2}
hue_selector = hue_lights['lamp']

# Default to 25% brightness
current_brightness = 25
```

The code sets up hue light identifiers in `hue_lights` and automatically selects the lamp identifier in the list. This prevents sending the bridge a None type if a button is pressed and no light is selected. It also sets a brightness default of 25%.

- For more information about setting up light identifiers, read the *Hue Lights Setup* section of this guide.
- **To enumerate all the lights connected to the bridge** , you can run the following line from your code: `my_lights = my_bridge.get_lights` and print the JSON response from the hue bridge: `my_lights` .

Main Loop

```
while True:
    touch = ts.touch_point
    if touch:
        for i, button in enumerate(buttons):
            if button.contains(touch):
              button.selected = True
```

The main loop checks for if the screen was touched. If it was, it searches for which button in the `button` list was touched.

Once the button was determined, the button's `selected` property is set to `True` - inverting the button's color until the action is fully performed (i.e: the light is changed, toggled, etc). By doing this, you are creating a visual status indicator.

```
if button.name == 'living':
                    hue_selector = hue_lights['livingroom']
                    print('Switching to ', hue_selector)
                elif button.name == 'room':
                    hue_selector = hue_lights['lamp']
                    print('Switching to ', hue_selector)
```

Then, the code checks the button's name against its function (what it does). If the button's name is lamp or room, `hue_selector` is toggled to the value of the button.

Whenever the code in the main loop sends data to the bridge to modify a light, it uses `hue_selector` to indicate the light being modified.

```
 elif button.name == 'onoff':
                    print('Toggling {0}...'.format(hue_selector))
                    my_bridge.toggle_light(int(hue_selector))
```

If the on/off button is tapped, the code will toggle the state of the selected light.

- The Hue Light API does *not* support toggling light state - we added a `toggle_light` method into the `CircuitPython_Hue` library to get the current state of the light , toggle it, and call `set_light` with the

toggled state of the light..

```
elif button.name == 'up':
                    current_brightness += 25
                    print('Setting {0} brightness to {1}'.format(hue_selector, current_brightness))
                    my_bridge.set_light(int(hue_selector), bri=current_brightness)
elif button.name == 'down':
                    current_brightness -= 25
                    print('Setting {0} brightness to {1}'.format(hue_selector, current_brightness))
                    my_bridge.set_light(int(hue_selector), bri=current_brightness)
```

When either of the brightness buttons are pressed, they'll modify the value of `current_brightness` by +/-25% and send that value to the bridge using `set_light`.

```
else:
  print('Setting {0} color to {1}'.format(hue_selector, button.name))
  my_bridge.set_light(light_id=int(hue_selector),
                      hue=int(hue_hsb[button.name][0]),
                      sat=int(hue_hsb[button.name][1]),
                      bri=int(hue_hsb[button.name][2]))
button.selected = False
```

If any of the color buttons are pressed, the color's hue, saturation, and brightness values are individually passed into `set_light` along with the light (`hue_selector`).

Since the code is finished processing the action, the button's fill is set to its original color by de-selecting the button (`button.selected = False`).

Going further!

This guide has only scratched the surface of the Philips Hue API! We've detailed out a good amount of the API actions within the Adafruit_CircuitPython_Hue (https://adafru.it/Ezw) library, like discovering new bulbs or setting a scene.

If you didn't see the API action you were looking for, feel free to add it to the library. You may find it useful to read through the library and the API reference in different tabs, and cross-referencing them (Docs are here, you'll need to create an account (https://adafru.it/Ezz))

If you end up adding a feature to the library - pull requests on the GitHub repository are appreciated!

- If you are not sure how to create a pull request, Kattni has a fantastic guide about contributing to CircuitPython using GitHub (https://adafru.it/EvC).