Arcade Button Control Box

Created by Ruiz Brothers

https://learn.adafruit.com/arcade-button-control-box

Last updated on 2024-03-08 02:36:52 PM EST

Table of Contents

Overview

Custom Controller Box

In this project, you'll learn how to build a basic USB HID keyboard for triggering things like commands and hotkeys for controlling any number of software and hardware. We'll use an Adafruit Feather M0 Express, a handful of arcade buttons and Circuit Python to make a DIY keyboard controller.

Circuit Python makes this project super simple to program and easy to update - no need for a compiler, IDE, or any special drivers. Just plug it in and open up the text file in the virtual USB key to reprogram the keys whenever you want.

When this box is connected to your computer, it behaves just like a USB HID Keyboard. Press a button and it types a letter! It's really simple and easy to manipulate the software so you can output single characters, or string multiple characters together to execute commands! The LEDs also light up each time you press a button. Sound like an interesting project? Let's get started!

Prerequisite Guides

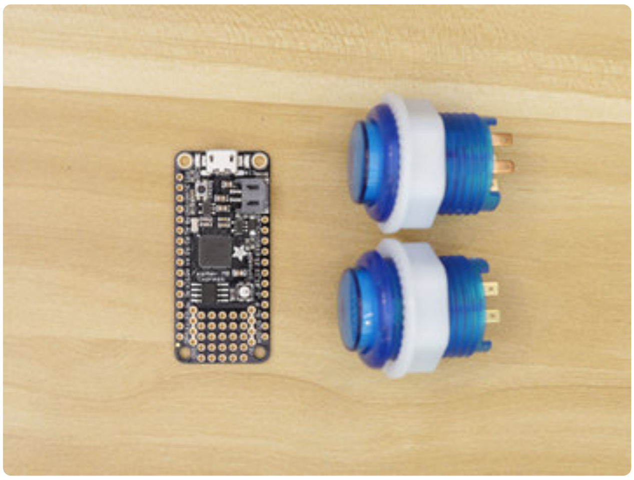
If your new to electronics and the Adafruit Feather M0 Express, I suggest you walk through the following guides to get the basics. The Adafruit Feather M0 Express guide will walk you through setting it up with CircuitPython.

- Collin's Lab – Soldering (https://adafru.it/wsa)

- Adafruit Feather M0 Express (https://adafru.it/vQd)

24mm Arcade Buttons

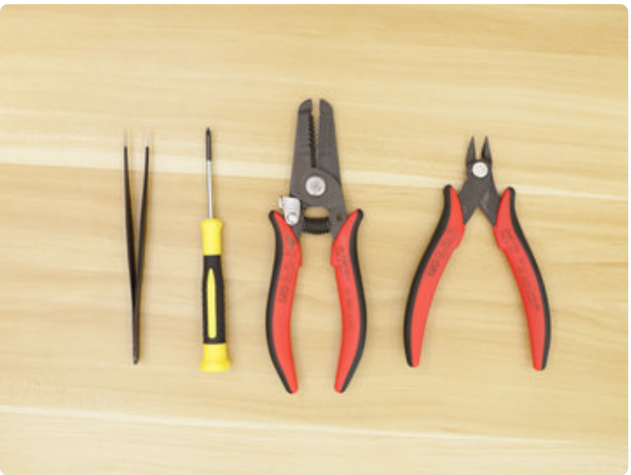
A button is a button, and a switch is a switch, but these translucent arcade buttons are in a class of their own. Particularly because they have LEDs built right in! That's right, you'll be button-mashing amidst a wash of beautiful light with these lil' guys. They're the same size as common miniature arcade controls, and require a 24mm diameter hole for mounting.



Components

For this project, we're using the Adafruit Feather M0 Express. It's got on-board SPI flash and a special bootloader that allows you to use different programming languages. We'll use CircuitPython to create a emulated HID keyboard. For the buttons, we'll use 24mm arcade buttons.

1 x Adafruit Feather M0 Express Designed for CircuitPython	https://adafruit.com/products/3403
4 x Mini LED Arcade Button 24mm Pick Your Color	https://adafruit.com/products/3429



Tools & Supplies

To put together the electronics, we need a few tools like a soldering iron and some wire cutters. I recommend using helping third hands and a panavise jr to help you solder things – They help keep things sturdy and in place, making it easier to solder. You'll also need some handy tools and hardware.

Holds things steady	
1 x Panavise Jr. Holds things steady	https://www.adafruit.com/product/151
1 x Helping Third Hands Helps holds wires steady	https://www.adafruit.com/product/291
1 x 30AWG Wire Silicone cover stranded wire	https://www.adafruit.com/category/473
1 x Flush Cutters Hakko Precision Flat Pliers	https://www.adafruit.com/product/1368
1 x Wire Strippers Hakko Professsional Quality 20-30 AWG Wire Strippers	https://www.adafruit.com/product/527
1 x Solder Iron Heat pen used for melting solder wire	https://www.adafruit.com/new?q=soldering%20iron&
4 x Machine Screws M2.5 x 5mm Phillips Flat Head	https://www.albanycountyfasteners.com/2-5-MM-x-45-Phillips-Flat-Head-Machine-Screw-p/1011-1002.htm
1 x Tweezers Fine tip straight tweezers - ESD safe - 135mm	https://www.adafruit.com/product/421
1 x Precision Screw Driver Precision screwdriver set (6 pieces)	https://www.adafruit.com/product/424

3D Printed Case

All of the components will be housed in a 3D printed box. It's a two-piece design that features a "snap-on" cover. The cover is specifically designed to house the Adafruit Feather boards using two machine screws. The CAD model is parametrically driven, so it's easy to modify the design.

No 3D Printer? No Problem!

If you don't have access to a 3D printer, we suggest checking out a 3D printing service like 3DHubs.com. There, you can search and find a local maker who can print the parts and ship them to you! Just download the STLs and upload them, you can browse through a list of local 3D printer operators and choose your material and the color you want the parts to be printed in.

Ideas, Ideas, Ideas!

Game Controller

Make an arcade style game controller to play retro games. These are after all, arcade buttons! They're fun to press and work well for game controllers.

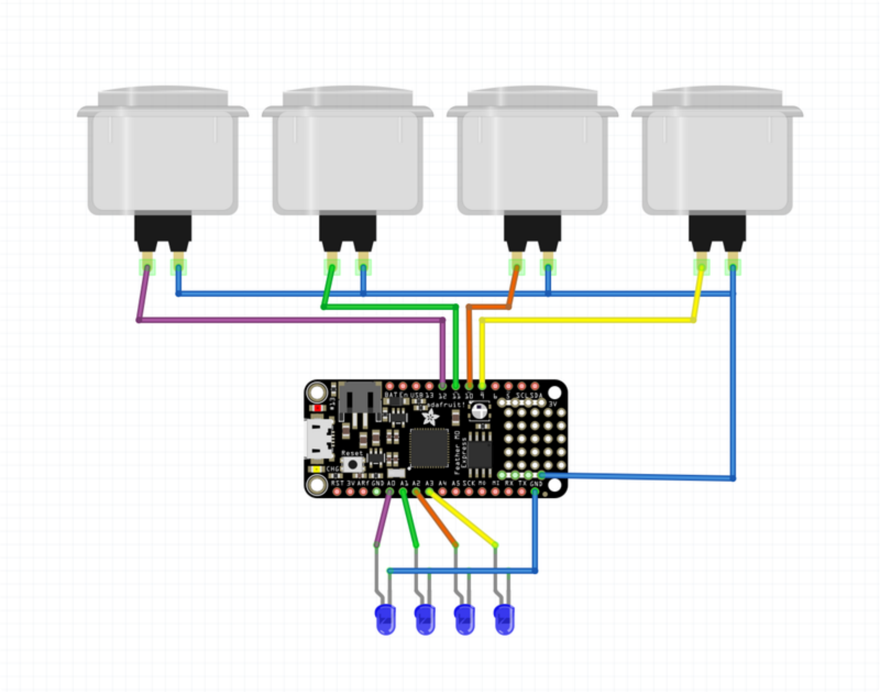
Media Editing Controller

Use this to quickly switch scenes in wirecast, change cameras in adobe premiere or final cut pro. Execute shortcut keys, commands, tools and other handy things with a push of a single button.

Assistive Technology Switch

With easy to press buttons and large surface area, this could be quite handy for AT projects. Make a custom project to trigger any number of systems and applications.

Circuit Diagram



Circuit Diagram

This provides a visual reference for wiring of the components. They aren't true to scale, just meant to be used as reference. The LEDs are embedded into the arcade button housing. They appear separate in the diagram for clarity.

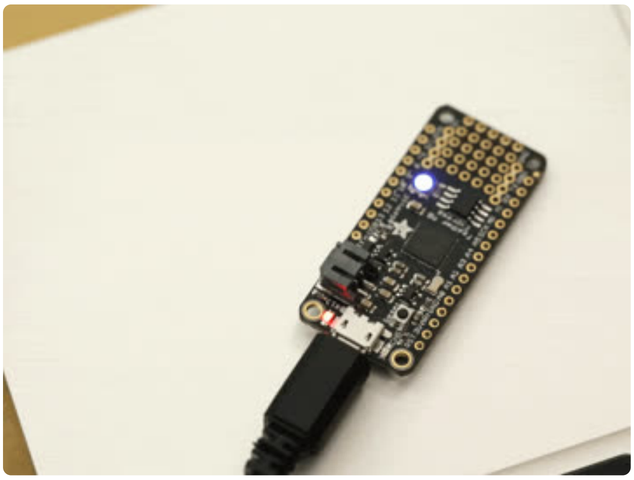
To power this project, we're connecting microUSB to a computer's USB port.
This doesn't require any external power like from a battery.

- D12, D11, D10, D9 from Adafruit Feather to Arcade button
- A0, A1, A2, A3 from Adafruit Feather to Arcade button
- Ground from Adafruit Feather to Arcade buttons

The buttons and LEDs will share a common ground. To make wiring easier, we'll connect the grounds in series.

Number Of Buttons

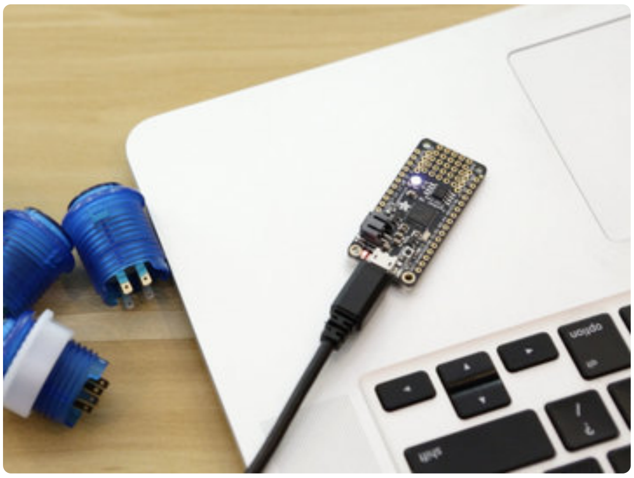
You can wire up to six different buttons to the Adafruit Feather using data pins 12-9. The LEDs can be wired to analog pins 0-5. If you need more buttons, you'll have to use multiplexing which is beyond the scope of this learning guide.



USB Power

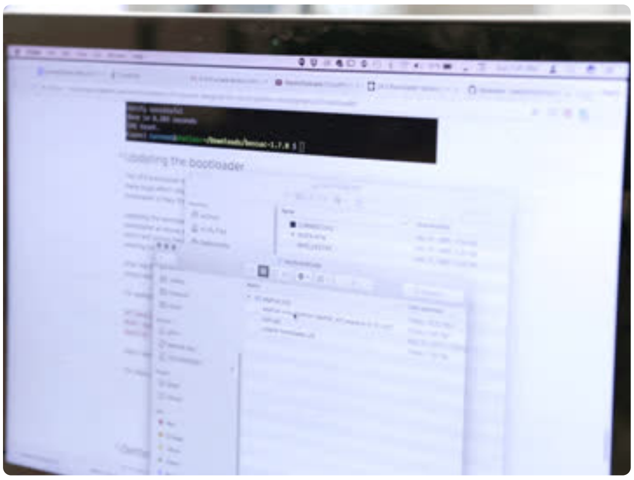
This project does not require a battery. It uses the USB port from the computer . The Adafruit Feather has an on-board battery charger to use lipoly batteries (https://adafru.it/waX) but there isn't enough space in the enclosure to house a battery. However, the case can be modified to fit a battery – Just need to increase the height of the case. Note you still need to plug it into USB to use it as a keyboard

Software



Setup Adafruit Feather M0 Express for CircuitPython

We'll need to get our Feather board setup so we can run CircuitPython code. First thing we'll need to do is connect the board to your computer with a microUSB cable. Then double-click on the reset button to put it in "UF2" boot-loader mode. The NeoPixel will turn green. The board will then show up as a USB storage device on your computer named "FEATHERBOOT".



Install CircuitPython UF2

Follow our step-by-step guide for installing CircuitPython (https://adafru.it/Amd)

After you've dragged the **UF2** onto the **FEATHERBOOT** drive, wait for a few moments, and a **CIRCUITPY** drive will appear letting you know that circuit python has been loaded correctly. You may need to unplug-replug the Feather to reset it.

Download Adafruit CircuitPython HID Library

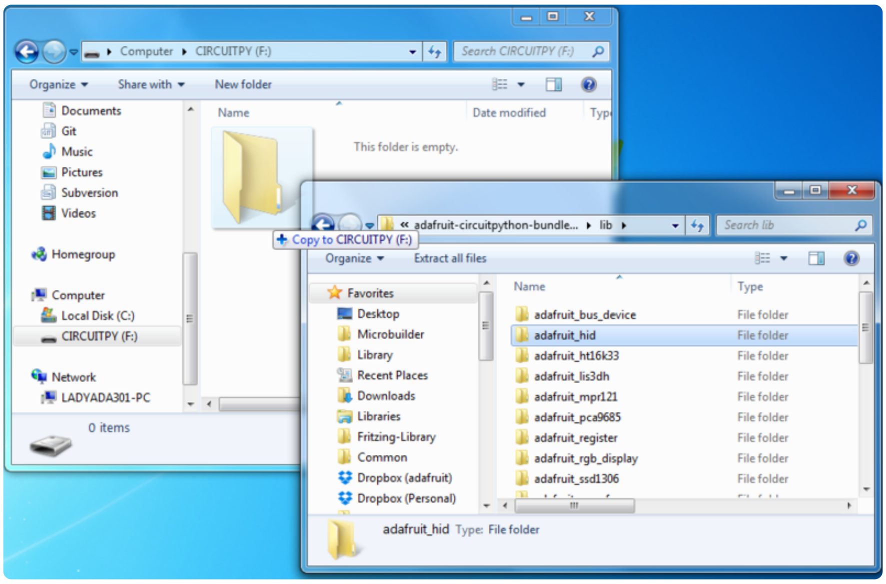
Now we need to get the HID library from github. This allows us to have the Feather act like a keyboard

Visit our library installation page to learn how to download and install the latest driver bundle!

Learn How To Install the Latest Driver Bundle

https://adafru.it/ABU

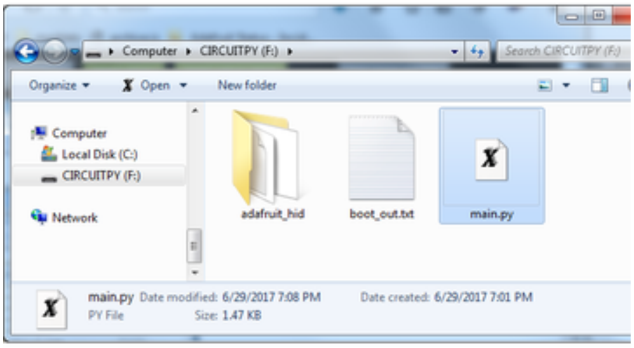
You can install the whole bundle if you have an Express board, or just the **adafruit_hid** folder. If you're just installing the individual driver, stick the **adafruit_hid** folder into the **CIRCUITPY/lib** folder or just into **CIRCUITPY**



Upload The Code

Copy and paste the code below into a new text document (we recommend using Mu as your editor, which is designed for CircuitPython. (https://adafru.it/ANO)). Save the file and name it as **main.py**

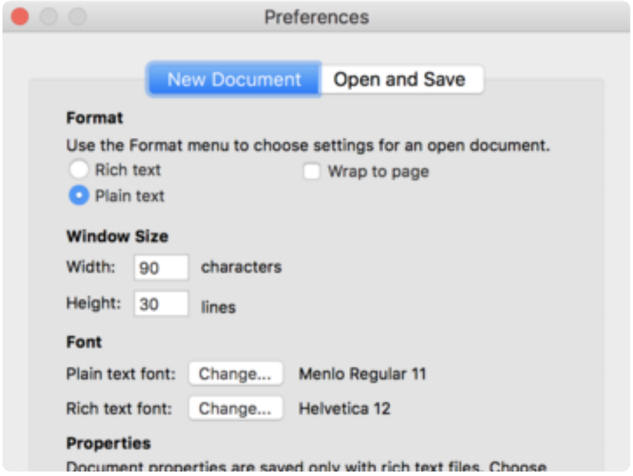
Once the files has been uploaded to the drive, the Feather will automatically reboot and run the code. No upload button (say whaaat?!).



main.py Date modified: 6/29/2017 7:08 PM Date created: 6/29/2017 7:01 PM
PY File Size: 1.47 KB

Text Document Formatting

We recommend using Mu as your editor, which is designed for CircuitPython. (https://adafru.it/ANO)



Format

Use the Format menu to choose settings for an open document.

○ Rich text ☐ Wrap to page

● Plain text

Window Size

Width: 90 characters

Height: 30 lines

Font

Plain text font: Change... Menlo Regular 11

Rich text font: Change... Helvetica 12

Properties

Document properties are saved only with rich text files. Choose

If you're using something else, watch out for formatting! When making your text document, you need to ensure the file is set as **Plain Text**. Most common text editing applications, like **TextEdit** for MacOS will save text documents as **.RTF (rich text format)** by default. You can quickly change an RTF text document to plain text by using selecting "**Make Plain Text**" under the **Format** menu. You can also change the format in the applications "**Preferences**" menu.

Line Spaces and Invisible Characters

If you are still finding your code isn't quite working and running. You can try copying the code into a different code or text editing software, save it out as a .txt format with line spacing and then convert it to the **.py** file extension. Sometimes text editors will add invisible characters like line breaks and tabbed spaces.

```
# SPDX-FileCopyrightText: 2017 Limor Fried for Adafruit Industries
#
# SPDX-License-Identifier: MIT
```

```
import time

import digitalio
from adafruit_hid.keyboard import Keyboard
from adafruit_hid.keycode import Keycode
import board
import usb_hid

# A simple neat keyboard demo in circuitpython

# The button pins we'll use, each will have an internal pullup
buttonpins = [board.D12, board.D11, board.D10, board.D9, board.D6, board.D5]
ledpins = [board.A0, board.A1, board.A2, board.A3, board.A4, board.A5]

# The keycode sent for each button, will be paired with a control key
buttonkeys = [Keycode.A, Keycode.B, Keycode.C, Keycode.D, Keycode.E, Keycode.F]
controlkey = Keycode.LEFT_CONTROL

# the keyboard object!
kbd = Keyboard(usb_hid.devices)
# our array of button objects
buttons = []
leds = []

# make all pin objects, make them inputs w/pullups
for pin in buttonpins:
    button = digitalio.DigitalInOut(pin)
    button.direction = digitalio.Direction.INPUT
    button.pull = digitalio.Pull.UP
    buttons.append(button)
for pin in ledpins:
    led = digitalio.DigitalInOut(pin)
    led.direction = digitalio.Direction.OUTPUT
    leds.append(led)

led = digitalio.DigitalInOut(board.D13)
led.switch_to_output()

print("Waiting for button presses")

while True:
    # check each button
    for button in buttons:
        if not button.value:  # pressed?
            i = buttons.index(button)
            leds[i].value = True

            print("Button #%d Pressed" % i)

            # turn on the LED
            led.value = True

            while not button.value:
                pass  # wait for it to be released!
            # type the keycode!
            k = buttonkeys[i]  # get the corresp. keycode
            kbd.press(controlkey, k)
            kbd.release_all()

            # turn off the LED
            led.value = False
            leds[i].value = False

    time.sleep(0.01)
```

Modify the Code

Now that the code lives on the Adafruit Feather board, it's super easy to change or update it. We can change the number of pins, their wiring, and what key-codes they send.

Open up the **main.py** file in your favorite text editor and take a look at the code.

If you want to change the pins for the buttons, look for the `buttonpins` list variable:

```
# The button pins we'll use, each will have an internal pullup
buttonpins = [D12, D11, D10, D9, D6, D5]
```

The "ledpins" variable lists which analog pins we're using, they correspond with the button pins one-to-one

```
 ledpins = [A0, A1, A2, A3, A4, A5]
```

So here, the first pin name is the LED connected to pin **A0**, which matches up with the first button input pin **D12**. They match up **A1**+**D11**, **A2**+**D10**, **A3**+**D9**, **A4**+**D6**, and **A5**+**D5.** To change the connections, simply change the pin names in the list and save

Changing Key Presses

The `buttonkeys` and `controlkey` variables list which characters we want the buttons to output.

```
# The keycode sent for each button, will be paired with a control key
buttonkeys = [Keycode.A, Keycode.B, Keycode.C, Keycode.D, Keycode.E, Keycode.F]
```

For example, when the **D12** button is pressed, it will emit a `Keycode.A`. and when D11's button is pressed, you'll see a `Keycode.B`. You can pick a wide variety of keycodes, see the full list here (https://adafru.it/AOi).

Note that keycodes aren't the same as ASCII codes. So for example if you want to send a upper case A you need to send both a control key that is 'shift' and then the keycode `Keycode.A`. Together, they will make your computer recognize it's an A you want. You can set the control keycode that goes with each key on the next line:

```
controlkey = Keycode.LEFT_CONTROL
```

In this case, we want to send a Left "Control" keypress at the same time. Try changing this to

```
controlkey = Keycode.SHIFT
```

and save **main.py** to see how it now sends uppercase letters.

If you want to get really creative with what keypresses to send, see this line:

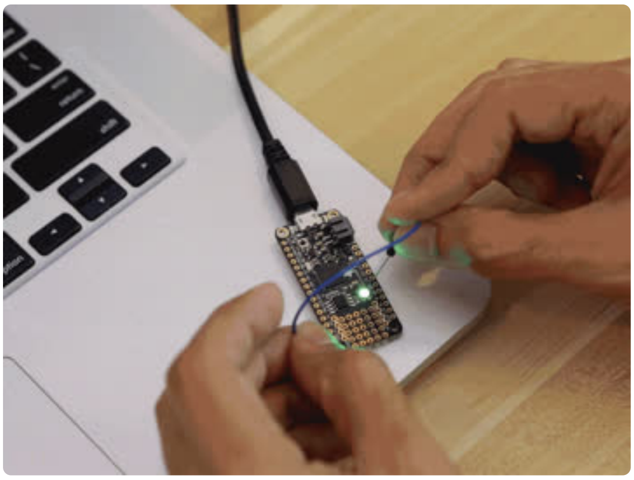
```
kbd.press(controlkey, k)
```

You can have up to 6 keycodes sent at once - so if you need control-shift-A, turn it into:

```
kbd.press(Keycode.SHIFT,Keycode.LEFT_CONTROL, k)
```

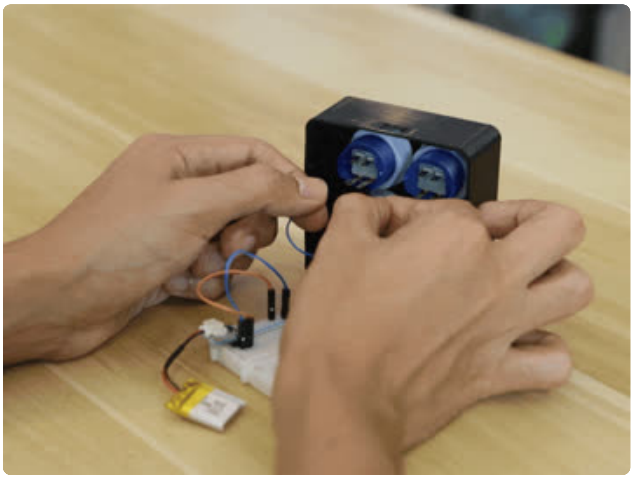
Coding Video

You have the option to add up to 6 buttons. You can watch Limor walkthrough the development of the software and explain how everything works. The CircuitPython HID Keyboard library is by Dan Halbert (https://adafru.it/xfz)and Scott Shawcroft (https://adafru.it/xfA).



Prototyping Circuit

Once the code has been uploaded to the board, you can quickly test to ensure everything is working as expected. Using a jumper cable, you can testing the keystrokes by tying D12-D5 and ground together. You should see key presses happen on your computer with accompanying red LED on the feather board.



Testing LEDs

The 24mm LED buttons have two sets of electrodes. It's a good idea to test out the LEDs and note the correct electrodes and polarity. The assembly page shows which electrodes goes to what. Use the icon marked on the button housing to determine orientation.

3D Printing

3D Printed Parts

This enclosure I designed for this project is a two piece design. The enclosure and the "snap-on" cover. There are several version of the enclosure that feature a number of different buttons layouts. For example, 2 by 2, 3 by 2 and a 4 by 4 button layout. You can choose which ever enclosure best suits your project.

Filaments

You can use regular PLA filament or composite and strong materials. Just be aware the tolerance may vary when using materials other than PLA.

Download STLs from YouMagine

https://adafru.it/xfB

Download STLs from Pinshape

https://adafru.it/xfC

Download STLs from Thingiverse

https://adafru.it/xfD

Modify Case Design

If you'd like to make adjustments to the case, you can download the Fusion 360 Archive for free and modify the model using your preferred CAD modeling program (STEP, IGHS, Solidworks, STLs, etc.). The design is parametrically driven with User Parameters, so it's very really update values such as the tolerances, thickness, height and number of buttons. The design will automatically update and scale depending on the values. Watch my "Layer by Layer" tutorials to get an in-depth walkthrough of the model.

Download Fusion 360 Source

https://adafru.it/xfE

User Parameters

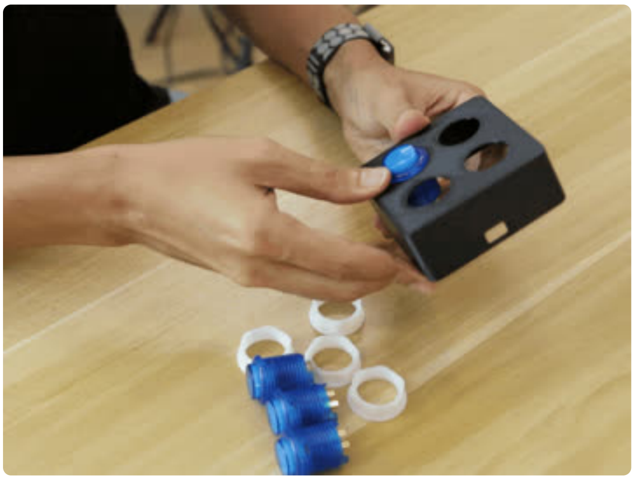
This is a list of the available parameters that you can quickly modify. To get these, simply open the "Change User Parameter" dialog under the Modify toolset.

- **across & down**: these control the amount of arcade buttons in the case.
- **spacing**: the amount of space between the arcade buttons.
- **offset**: the amount of "padding" around the outer edge of the case.
- **height**: overall height of the case.
- **diameter**: the diameter of the arcade button's cutout.
- **hole**: the diameter hole on the four standoffs for the Adafruit Feather board.
- **gap**: the "gap" or clearance between the surfaces that touch (snap fitting cover)
- **shell**: the thickness of the enclosure.
- **lipcut**: the width of the opening in the lip of the cover (allows clearance for the Feather)

Assembly

Install Feather

To start this project, I suggest securing the Feather to the cover of the 3D printed case. Grab the Feather board and place it over the standoffs. Orient the PCB so the micro USB port is facing the side with the "cutout". Line up the mounting holes with the holes in the standoffs. Insert two M2.5 x 5mm flat Phillips machine screws into the mounting holes and fasten them tightly with a Phillips screw driver. Fasten until the screws heads are flush with the PCB.

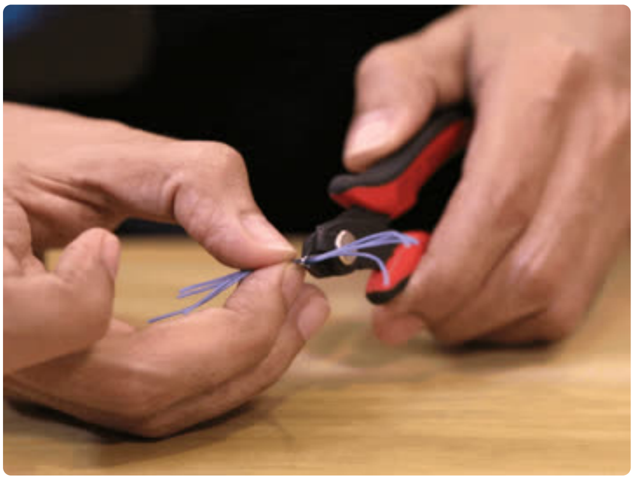


Install Buttons

Next, we'll work on the installing the arcade buttons into the 3D printed case. Remove the mounting rings from the buttons by unscrewing them. Then, insert the body of the buttons into the cutouts on the case. If the tolerances are loose, you can apply pressure and press them into the case until they're flush with the surface. You can also screw them into the cutouts. Secure the buttons to the case by reinstalling the mounting rings.

Wires for Ground

Next, we'll need to cut some pieces of wire for making the ground connections. I suggest using 30AWG silicone cover stranded-core wire. Depending on the amount of buttons you'd like to use, you'll need to make pieces of wire accordingly. For my 2x2 button layout, I needed a total of 8 wires (just for the ground connections).

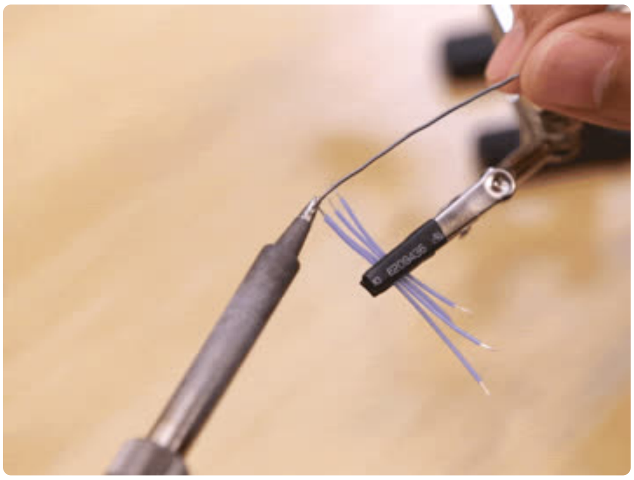


Measure Wires

The length of these wires will vary, but I suggest making them at least 8cm in length. Longer wires are good because you can always shorten them. The majority of the connections will be for common ground. In my 2x2 button case, the wires varied in length, as short as 5cm and as long as 10cm. Use wire cutters to cut the wires to your desired lengths.

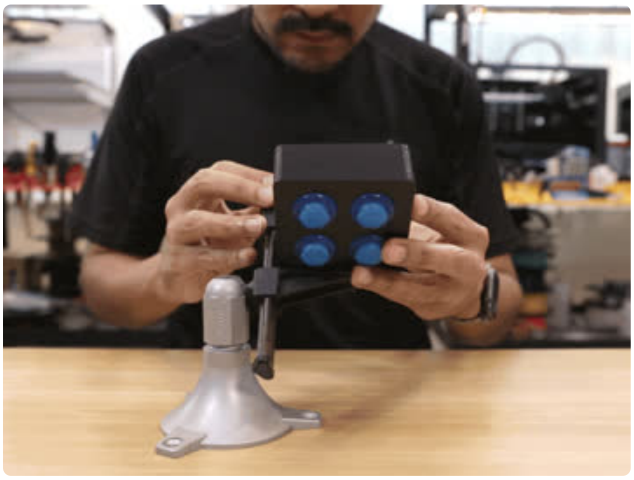
Strip Wires

Next, we'll need to strip the wires to expose a bit of the strands. Use wire strippers to remove a small amount of insulation. The exposed strands of 30AWG wire are really thin and can easily fray, so be careful handing them. We'll need to do this to both ends for all of the wires.



Tin Wires

Now we can tin the exposed strands of wire. You can this by adding a small bit of solder to wires using the tip of a soldering iron. This will make it easier to attach the wires to the electrodes on the bottom of the arcade buttons. A helping third hand can hold the wires steady and in place while you solder. I suggest grouping multiple wires to one of the grabbers so you can quickly tin them.

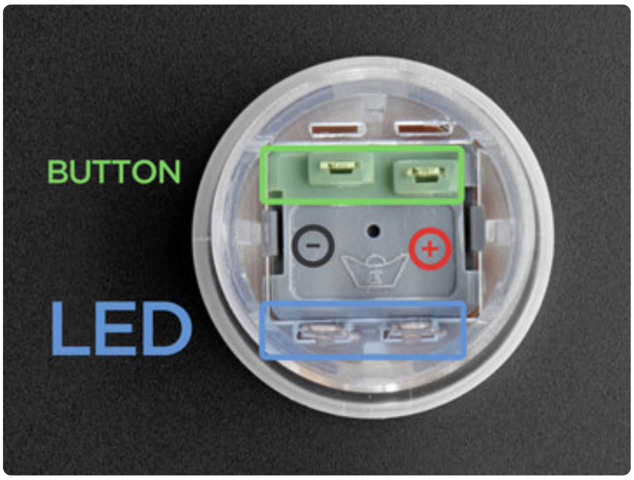


Secure Box

With our bits of wires cut, stripped and tinned, we can now work on connecting them to the buttons. I suggest securing the enclosure with the installed buttons to a panavise or similar. It'll make soldering much easier if the enclosure is mounted in place and stationary.

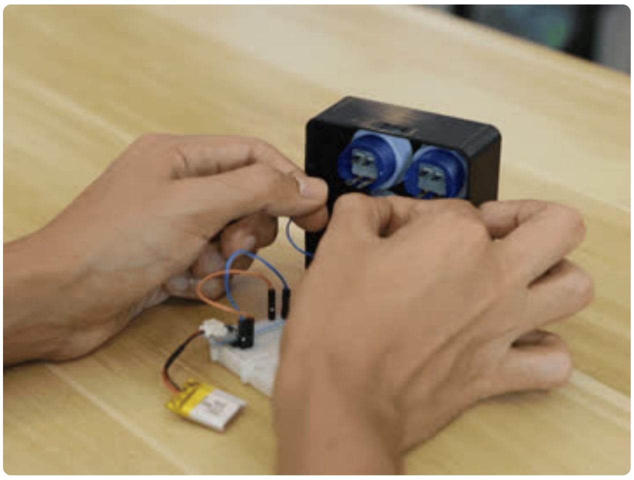
Button Tinning

Tin all of the electrodes on the arcade buttons by applying a small bit of solder. Each button has a set of two electrodes, four in total. The first set is for connecting the LEDs while the second is for the momentary switch.



Arcade Button Connections

Here's a close look at the electrodes. Take note of the orientation and markings on the button to help you understand the connections. We'll be connecting all of the ground together so they're wired in series. This means we'll use wires to connect from one ground to the next. This prevents from having to wire every single ground connection to a pin or GPIO. It's much easier if we have a SINGLE ground connection going to the Adafruit Feather instead of each button individually. So the goal is to connect one ground wire coming from one arcade button to a ground pin on the Adafruit Feather. The rest of ground connections from the arcade button will connect to each other, essentially "sharing" the ground connection.



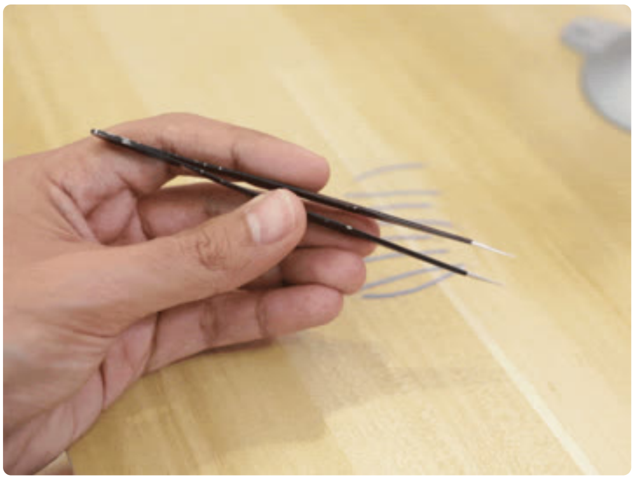
Test Button LEDs

If you haven't already, it's a good idea to test the LEDs in each button. To do this, you can used alligator clips (https://adafru.it/xfF) to easily connect the electrodes to a breadboard. You could also use jumper cables. You can also use a coin cell battery to apply power to the connections. Once you've tested the LEDs and determined the voltage and ground electrodes, take note!

Check Point

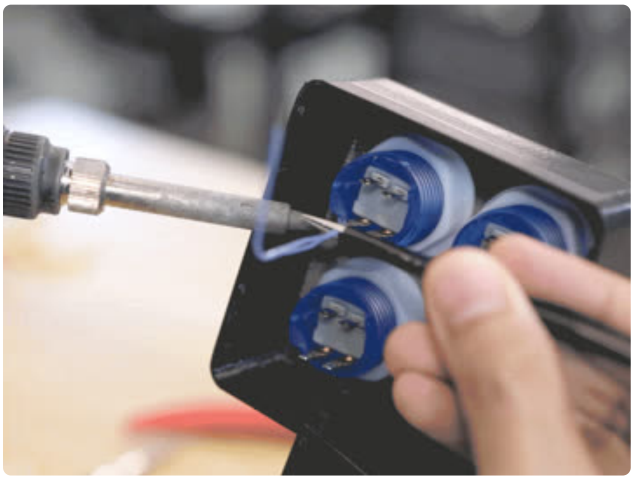
OK, we have our Feather and Arcade buttons installed and ground wires prepped. In the next page we'll work on making all of the wired the connections.

Wiring



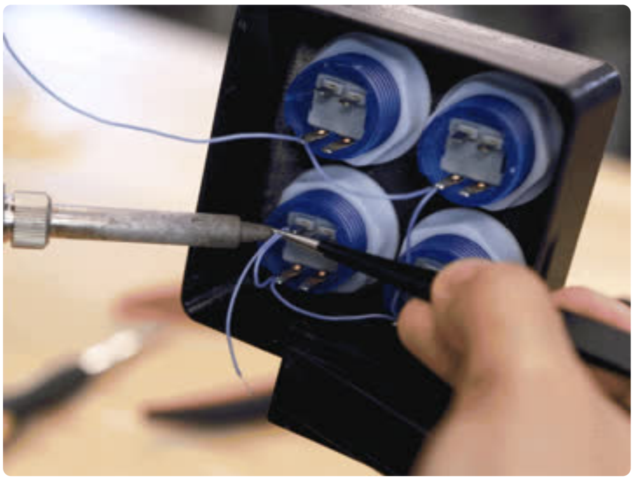
Handling Wires

I suggest using tweezers to handle the bits of wire. When soldering wires to things, they can get hot so this helps keep your fingers from getting burnt. Tweezers also help while soldering – You can get a better grip and get in close quarters.



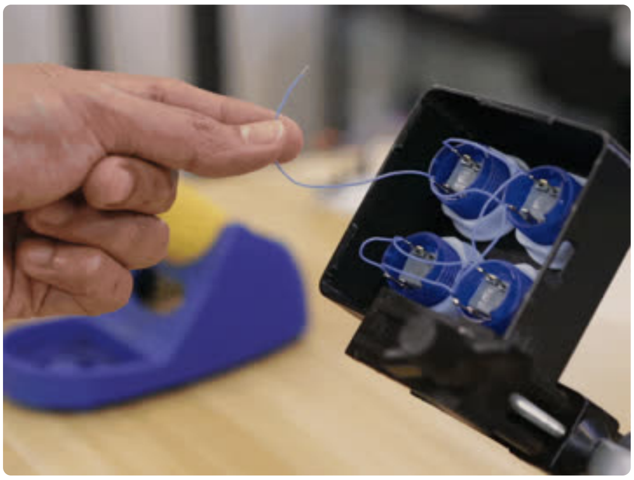
Connecting Ground

Attach two wires to one of the ground electrodes on one of the arcade buttons. For a 2x2 button layout, it didn't matter which button was first, but depending on your layout, you may want the first button to be closest to the Adafruit Feather board. Using the tip of the soldering iron, heat up the tinned electrode and place the two wires while the solder is molten.



Share Ground

With the two wires attached to the electrode, grab one of the wires and position it near the next arcade button. Grab another wire and hold both in place using the tweezers. Make sure the tips are very close to each. Place the two tips over one of the ground electrodes on the arcade button. Heat up the tinned electrode using the tip of the soldering iron while the two wires are touching to solder them together. Let the solder solidify before releasing the wires. We'll need to repeat this process for all the ground connections.

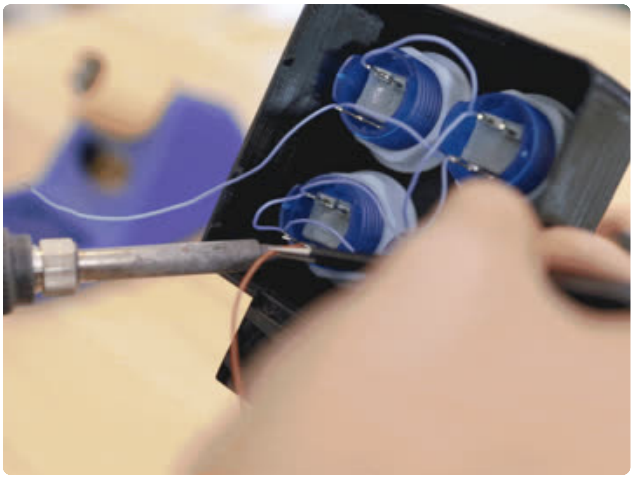


Ground Continued

When you've reached the last button, you'll need to jump to the second ground electrode – this will be either the LED or momentary switch, depending on which ever you started. Following the same process, repeat the steps to wire all of the ground electrodes together. When you've reached the last arcade button, you may need a fashion a longer wire in order to connect to the Adafruit Feather board.

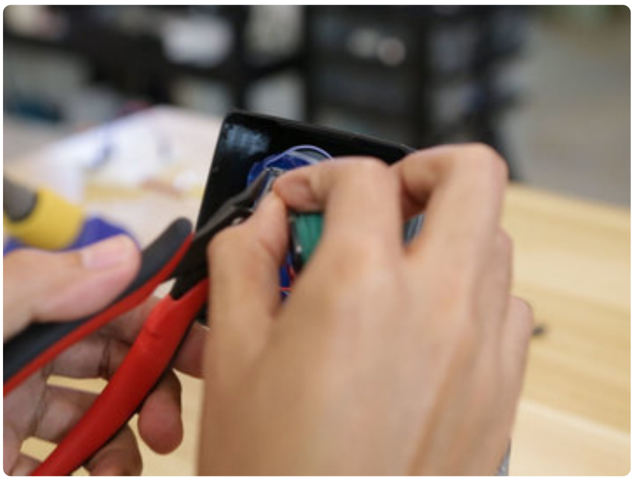
LED Wires for Anode

Next we'll need to make some new wires for connecting the anode's on the LEDs to the Adafruit Feather. We'll basically repeat the process like we did for all of the ground connections. We'll need to measure, cut, strip and tin all of the wires. These wires will not be shared and will connect to analog pins individually.



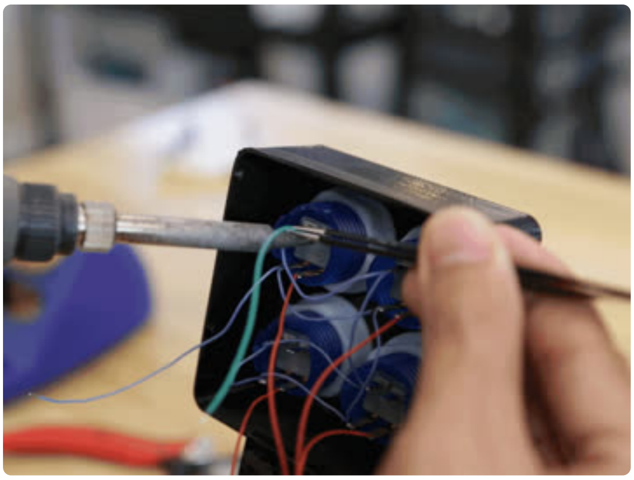
Solder LED Anode Connections

With all of the wires measured, cut, stripped and tinned, we can then attach them to the electrodes on the arcade buttons. Make sure you're connecting to the anodes of the LEDs. Connect the wires by soldering them to the electrodes.



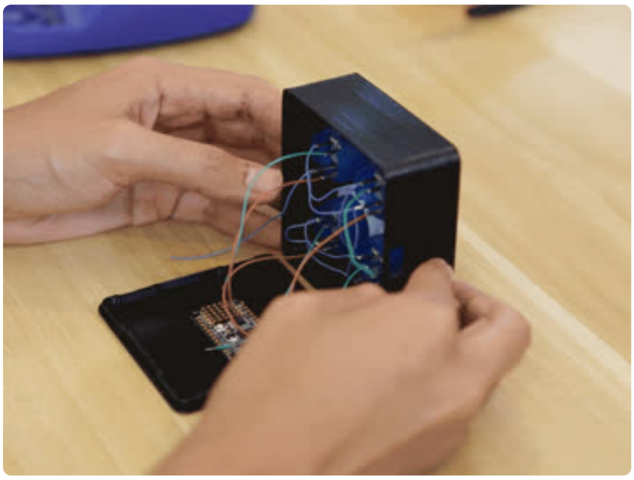
Button Wires for Signal

Next we'll need to make some new wires for connecting the momentary switch on the arcade buttons to the Adafruit Feather. Following the same process like we did for the ground and voltage wires, repeat this process. We'll need to measure, cut, strip and tin all of the wires.



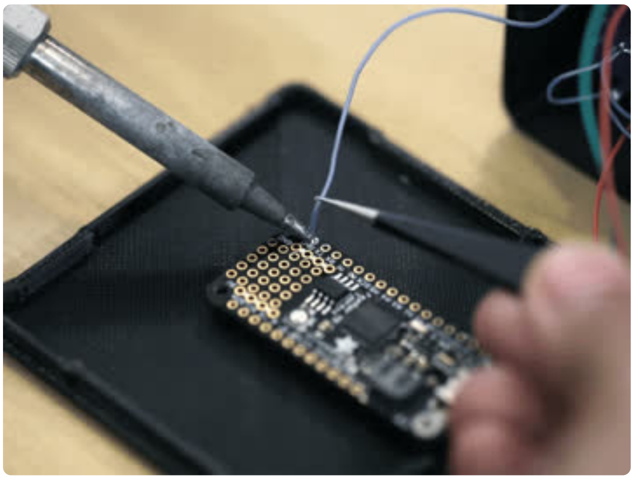
Solder Switch Wires

With all of the wires measured, cut, stripped and tinned, we can then attach them to the electrodes on the arcade buttons. Make sure you're connecting to the electrodes on the momentary switch. It should be the only remaining electrodes. Connect the wires by soldering them to the electrodes.



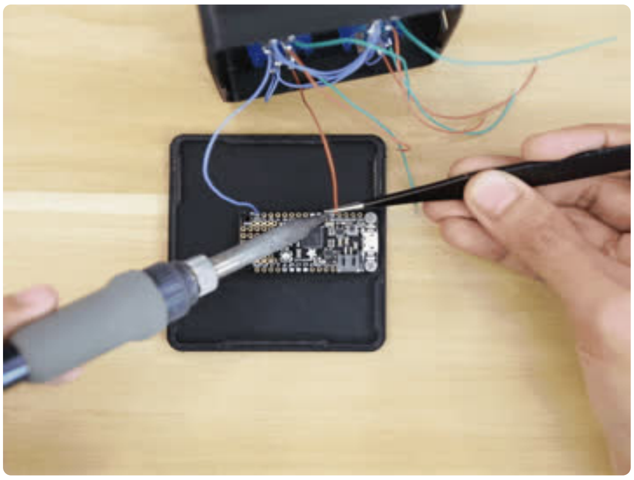
Connecting Wires to Adafruit Feather

OK now that we have all of our electrodes wired up, it's time to get them connected to the Adafruit Feather. Grab the cover with the Feather board secured to it and position it near the button box. Pick out the wires and check to ensure they can reach the pins on the Adafruit Feather. If you've left the wires extra long, great! We can trim those up now. If they aren't long enough, you might have to recut longer wires and connect those.



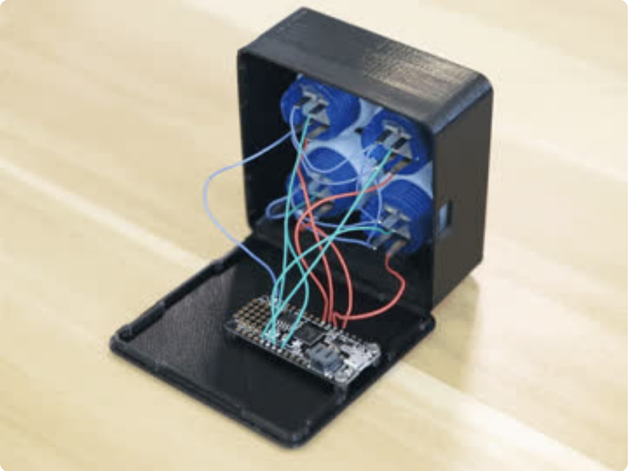
Connect Ground to Feather

The first connection we should make is the common ground wire coming from the buttons. There's a number of available ground pins on the Adafruit Feather, pick the one that best suits the location of the wire. Apply solder to your chosen ground pin to tin it. Then, insert the tip of the wire into the pin while keeping it heated with the soldering iron.



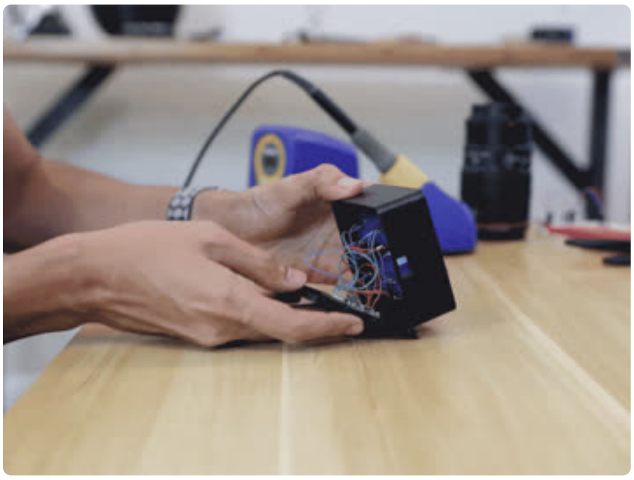
Solder Wires to Feather

Lastly, we'll connect all of the wires from the buttons to the Adafruit Feather. If your button has a specific layout, you'll need to map out the wires to their corresponding pins. You'll need to solder the LED wires to the analog pins on the Feather (A1–A5). Then, solder the switch wires to the digital pins (D12, D11, D10, D9, D6, D5).



Wired Connections

Once all of the wires have been soldered, double check to ensure they have a solid connection. Also a good idea to note which pins each button if wired to. If you found the wires are too long, you can shorten them – This will help keep the things inside the box manageable.



Close It Up

Now it's time to close it all up! Make sure to orient the Feather so the microUSB port is facing the cutout on the side of the case. Bring the two pieces together and make sure all of the wires are fitted inside the case. The lip on the cover will snap into the case. Little nubs run across the inner lining walls of the case will fit into indentations on the lip of the case. They'll lock in place when pressed together and you'll hear a satisfying "clicking" sound.

Make, Modify, Share

Congratulations! You've built your very own DIY USB HID keyboard. Did you modify it? What are you using it for? Let us know! Tag @adafruit on your favorite social network and use hashtag #adafruit so we can find it! We love sharing project makes from the community on our social channels.

If you have any technical questions, please post them up on our forums (https://adafru.it/dYq), we have a dedicated team of support engineers who are there to help!