Build Guide

All files are provided on the Github link. All components that are used and need to be purchased are in the BOM.

Prep

PCB/Electronics

1. Retrieve Files & Schematics
    a. PCB Github Link - File directory explanation
2. Source Components from Bill of Materials
    a. IR Gesture Sensor
        i. 1x IR Sensor
        ii. 1x Male 11-PIN JST Connector
        iii. 1x Female JST Connector
        iv. 1x I2C Multiplexer
    b. Gyroscope & Accelerometer
        i. 1x MPU6050
    c. Long force sensitive resistor
        i. 1x Interlink 408
    d. Linear Potentiometer
        i. 1x SoftPot Membrane Potentiometer
    e. Bend Sensor
        i. 1x Bend Sensor
    f. Haptic Driver
        i. 1x DRV2605L
    g. Haptic Motors
        i. 1x LRA
    h. Quad Level Shifter
        i. 1x 74AHCT125
    i. I2C Logic Level Shifter
        i. 1x Logic Level Converter
    j. Microcontroller
        i. 1xM4
    k. Headers
        i.
    l. Discrete Components
        i. 2xNmos
        ii. 1x 2.2k Ohm Resistor
        iii. 1x 10k Ohm Resistor
        iv. 2x 47k Ohm Resistor
    m. Wires
    n. Power Socket
        i. 1x 2.1mm Barrel Jack
    o. LEDs

        i. 1x 1m Dotstar
        ii. 1x 0.5m Dotstar
    p. Power Source
        i. 1x DC Power Supply Adapter
3. Order PCB
    a. Order through either pcbWay, oshpark, or other service.

Body

Following is a list of the required physical parts. The source of the parts can be found here: Optron BOM

Section of Optron	Optron ID number	Item Description	Distributor part number	MFG part number	Qty per 1 Optron	Cost per 1 pcs	Cost per 1 Optron	Required Purchasing quantity	Cost for Required quantity	Product/ site info
Core	M1-2020	Al Extrusion Track 20x20 x 1220 mm	HFS3-1515-1220	HFS5-2020-1220	1	$7.68	$7.68	1	$7.68	Misumi
	M1-0101	Muzata LED Channel	U103	U103	1	$32.99	$32.99	1	$32.99	Amazon
Fretboard	M2-0201	Teflon PFTE Film, 24" wide, 0.01" thick, 1ft length	8569K63	8569K63	1	$6.79	$6.79	0.33	$20.58	McMaster
	M2-0202	Silicone Rubber Strip, Grey, High-temp, Adhesive back, 3/4" wide, 1/32" thick	8622k52	8622k52	1	$7.43	$7.43	0.33	$22.52	McMaster
Securing, Fasteners	M1-0102	M3 Slide in T Nut for 2020 Sereis Aluminum Extrusion Profile Slot 6mm	BR-TN-0015	n/a	12	$0.16	$1.92	50	$7.99	Amazon
		M3 x 0.5 mm Thread Steel Phillips Flat Head Screws, 8 mm Long	91420A118		24	$0.03	$0.67	100	$2.80	McMaster Carr
		M3 x 0.5 mm Thread Stainless Steel Hex Nut	91828A211		42	$0.06	$2.33	100	$5.55	McMaster Carr
		M3 Stainless Steel Split Lock Washer	92148A150		24	$0.01	$0.24	100	$0.99	McMaster Carr
		M3 Nylon Plastic Washer	95610A530		18	$0.04	$0.65	100	$3.60	McMaster Carr

		M3 x 0.5 mm Thread Nylon Slotted Flat Head Screws, 8 mm Long	92929 A252		18	$0.09	$1.69	100	$9.40	McMaster Carr
Pinout Cabling		4 pin JST-XH Male thru-hole.			16	0.194	3.88	20	0.194	Digikey
		4 pin JST-XH Female thru-hole.			16	0.0728	1.82	25	0.0728	Digikey
		3 pin JST-XH Male thru hole.			4	0.19	1.14	6	0.19	Digikey
		3 pin JST-XH Female thru hole.			4	0.1	0.6	6	0.1	Digikey
		2 pin JST-XH Male thru hole.			2	0.15	0.6	4	0.15	Digikey
		2 pin JST-XH Female thru hole.			2	0.1	0.4	4	0.1	Digikey
		XH JST Contact			0.0363	80	5.445	150	0.0363	Digikey

3D Printing

Following is a list of the required 3D printed parts, as well the their specifications/files for 3D printing. The source of the parts can be found here: Optron BOM

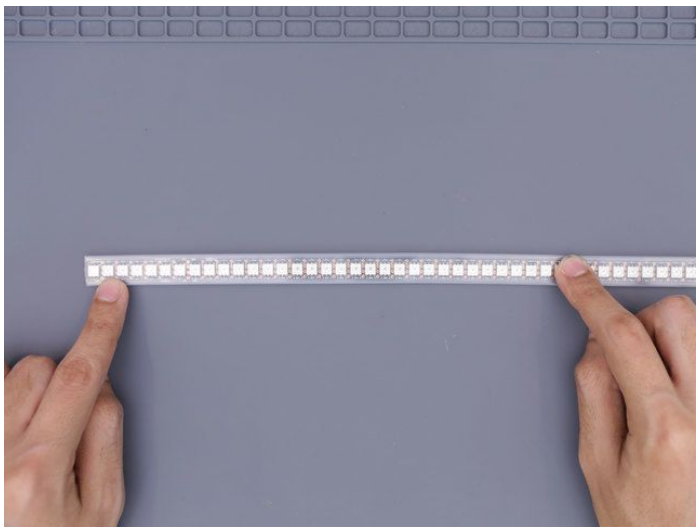
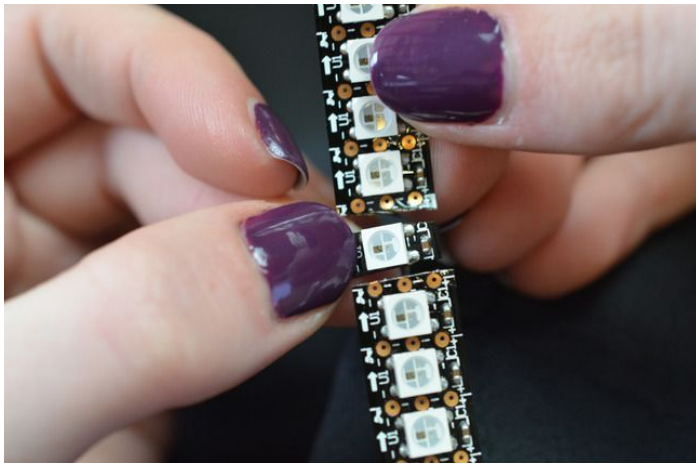
If you wish to view each part on the web, simply click on the STL link.

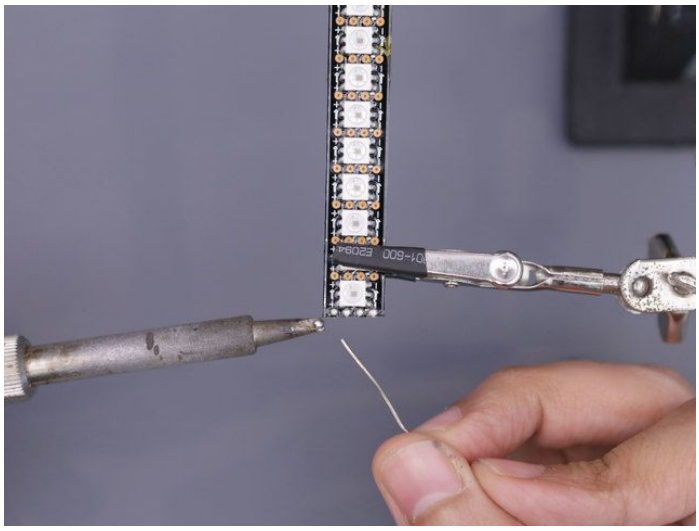
Name	Quantity	Grams	Total Grams	Infill	Layer Height	Generate Support	STL	gcode
FretBoard2.1	1	68.59	68.59	33	0.2	No	STL	gcode
FretBoardBottom2.1	1	67.86	67.86	33	0.2	Yes	STL	gcode
FretBoardTop2.1	1	70.65	70.65	33	0.2	No	STL	gcode
FretBoardWireManager2.1	1	4.25	4.25	33	0.2	Yes	STL	gcode
PCBMount2.1	1	23.21	23.21	33	0.2	Yes	STL	gcode
SlidingWireManger2.1	3	71.62	214.86	33	0.2	No	STL	gcode
SlidingWireMangerSimple2.1	4	53.54	214.16	33	0.2	No	STL	gcode
SlidingWireManagerSimpleStrapmount2.1	0	62.48	0	33	0.2	No	STL	gcode
SlidingWireManagerStrapmount2.1	1	80.38	80.38	33	0.2	No	STL	gcode
ZXGestureSensorMount2.1	4	47.52	190.08	33	0.2	Yes	STL	gcode
ZXGestureSensorMountSimple2.1	4	35.24	140.96	33	0.2	Yes	STL	gcode

Assembly

Step 1

Since just one 1 meter Adafruit Dotstar LED strip isn't enough, you will need to extend it by soldering on an additional 25 LEDs to the original 144 LEDs on the 1 meter strip.

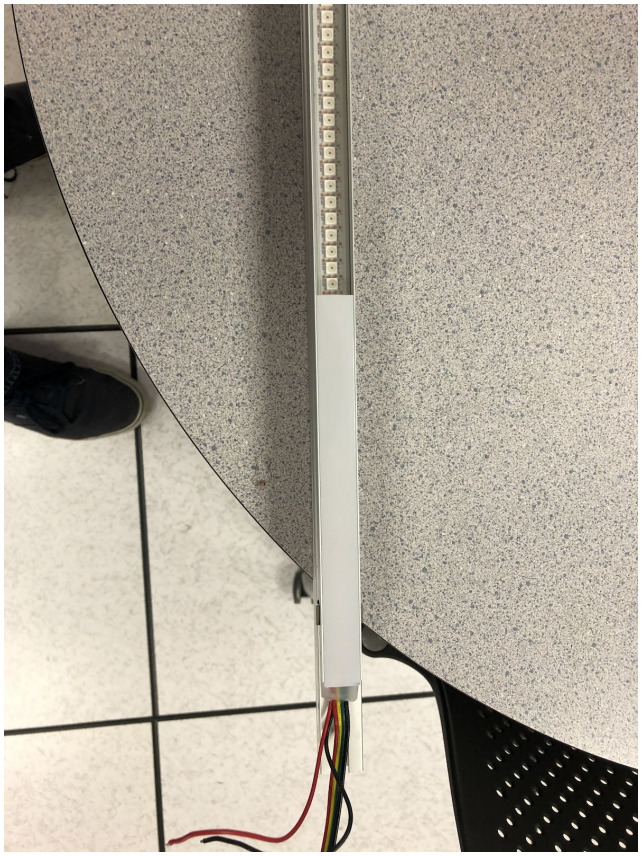
	Start by counting out 26 LEDs on the 0.5 meter Adafruit Dotstar LED strip. Plan to cut the traces using the 26th LED as a sacrificial LED. This should leave plenty of room on the traces of the 25th LED for soldering.
	Cut the traces. Try to leave as much plastic as possible on the sleeve, as it will be used to reseal the LED strip after soldering.

TODO	Trim the sleeves of both strips down the middle and peel the plastic back. This should expose the traces for easier soldering while allowing them to be resealed.
	Add a tiny bit of solder to each of the pads before attempting to solder the 0.5 meter strip to the 1.0 meter strip. If you have access to one, I recommend using a hot air rework to solder the traces together. Make sure to have all the data arrows on the strips pointing in the same direction.

TODO	To reseal the now 169 LED long Dotstar peel the sleeves back over themselves and hot glue them closed.

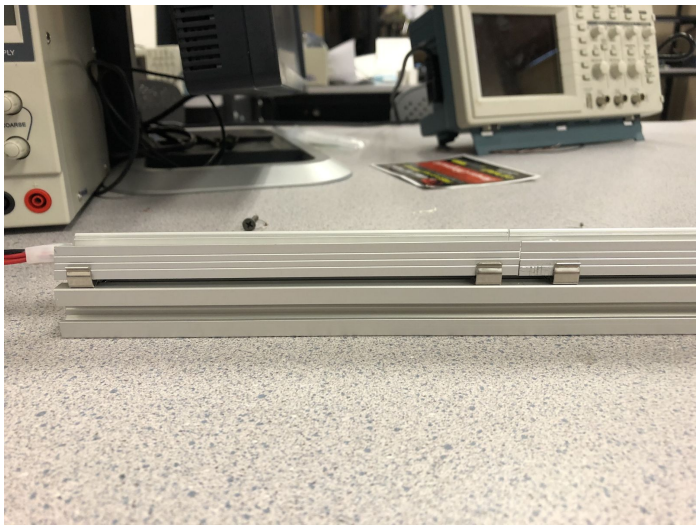
Step 2

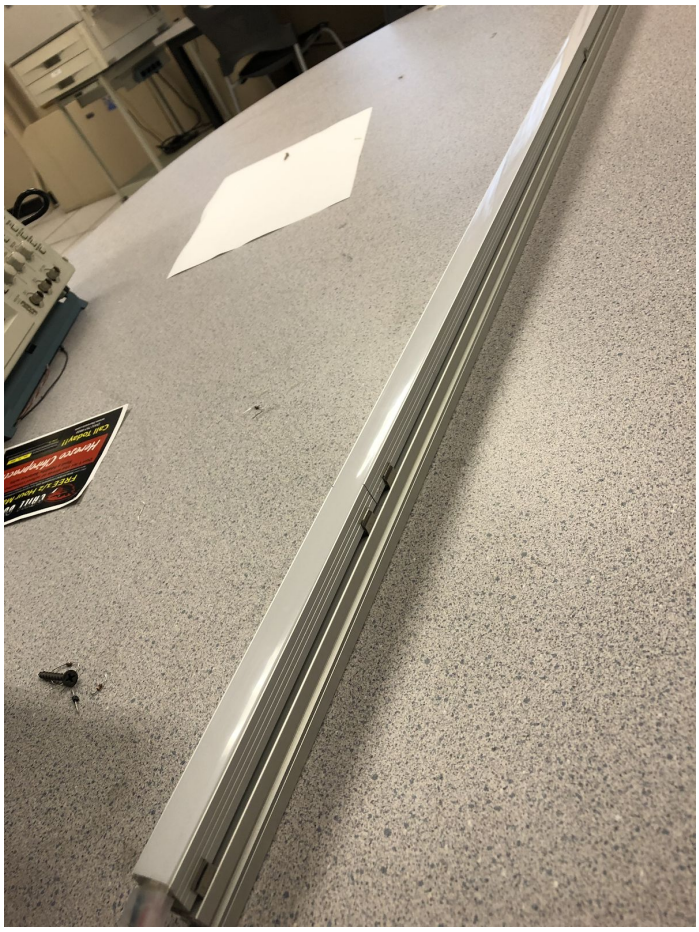
A single Muzata LED channel is 3.3ft long, which isn't long enough to hold all 169 LEDs. You will need to cut a part off of one of the LED channels, as well as the diffusers. I suggest using a hack saw for the LED channel, and a big pair of clippers or craft knife for the diffuser.



Step 3

To attach the Muzata LED channels you will need to craft some mounts.

	Each mount consists of a Muzata LED channel clip, a M3 Slide in T Nut, a 8 mm M3 x 0.5 mm screw, and an M3 split lock washer. Assemble loosely as depicted in the photo.
	You will want to make at least 5 of these mounts, although more mounts will lead to better heat dissipation and mounting strength. After making the mounts slide them on one at a time. Once they are in place, tighten the screw down to secure them.

	After placing the mounts snap the short LED channel and long LED channel down. Place the LED strip into the channel. Then snap the diffusers on top of the LED channel.

Step 4

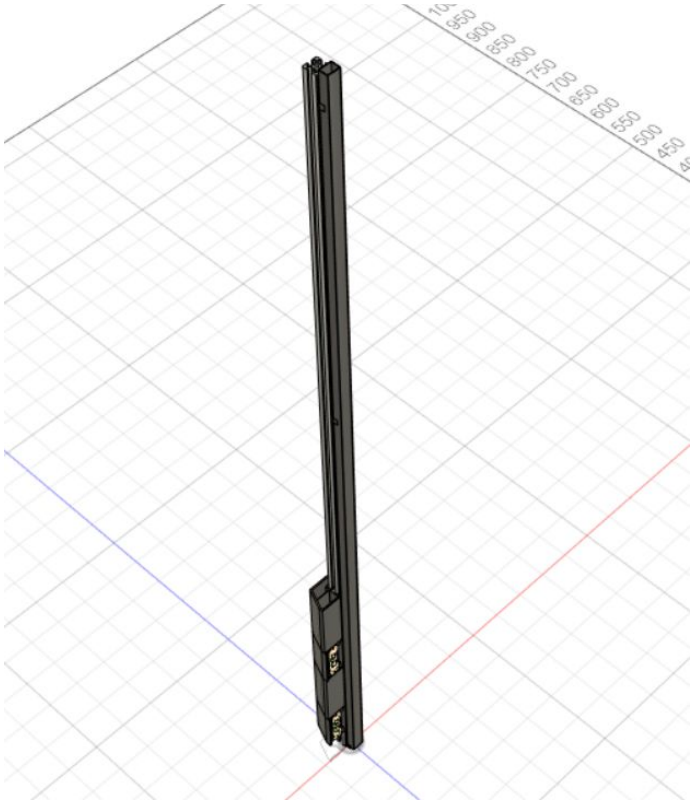
Slide on ZX gesture sensor parts onto the aluminum extrusion. These parts allow the ZX gesture sensors to be mounted, as well as provide a way to manage the wiring. One of the parts includes a strap mount.

Slide on ZXGestureSensorMountSimple2.1	Slide on SlidingWireMangerSimple2.1

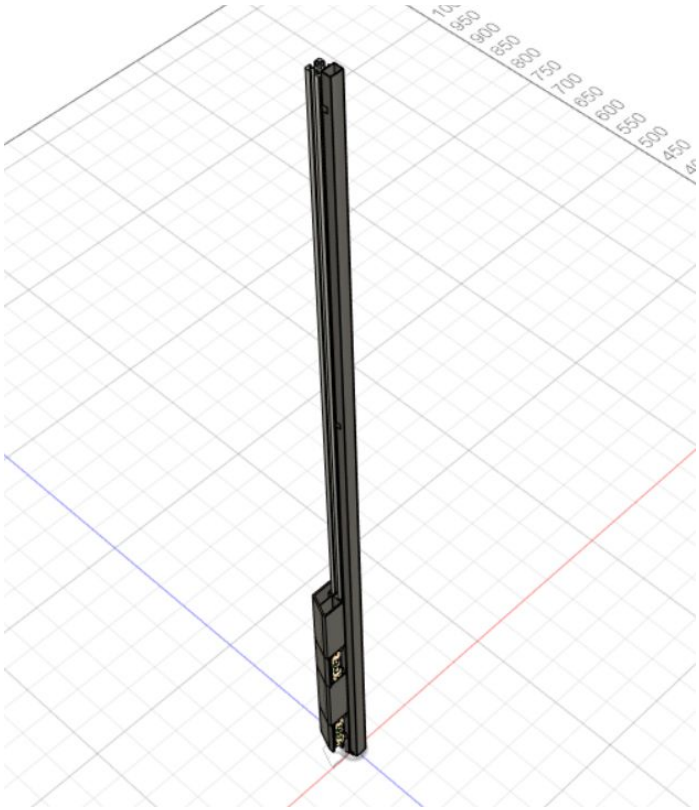
Slide on ZXGestureSensorMountSimple2.1

Slide on SlidingWireMangerSimple2.1

Slide on ZXGestureSensorMountSimple2.1



Slide on SlidingWireMangerSimple2.1



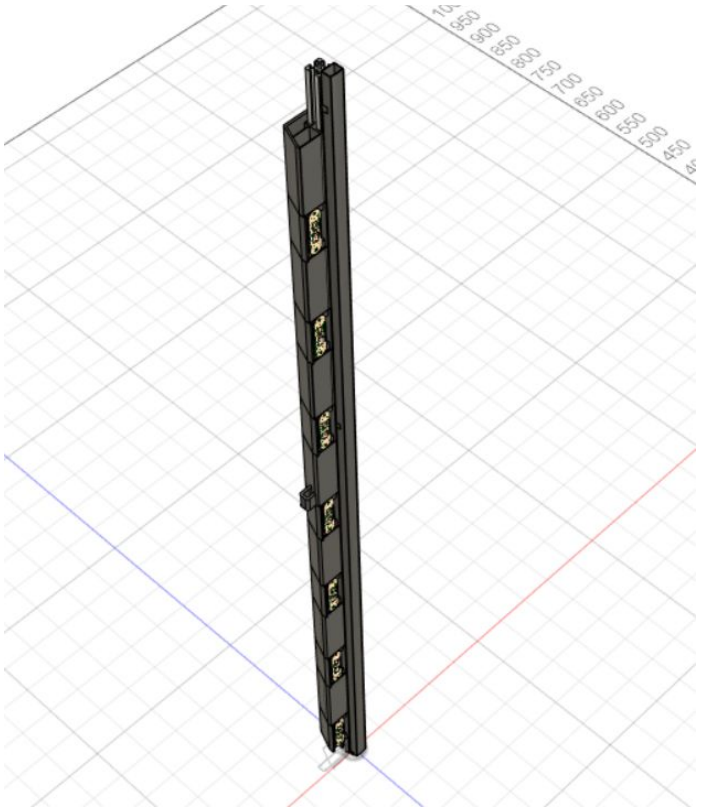
Slide on ZXGestureSensorMountSimple2.1

Slide on SlidingWireManagerStrapmount2.1

Slide onZXGestureSensorMount2.1

Slide on SlidingWireManger2.1

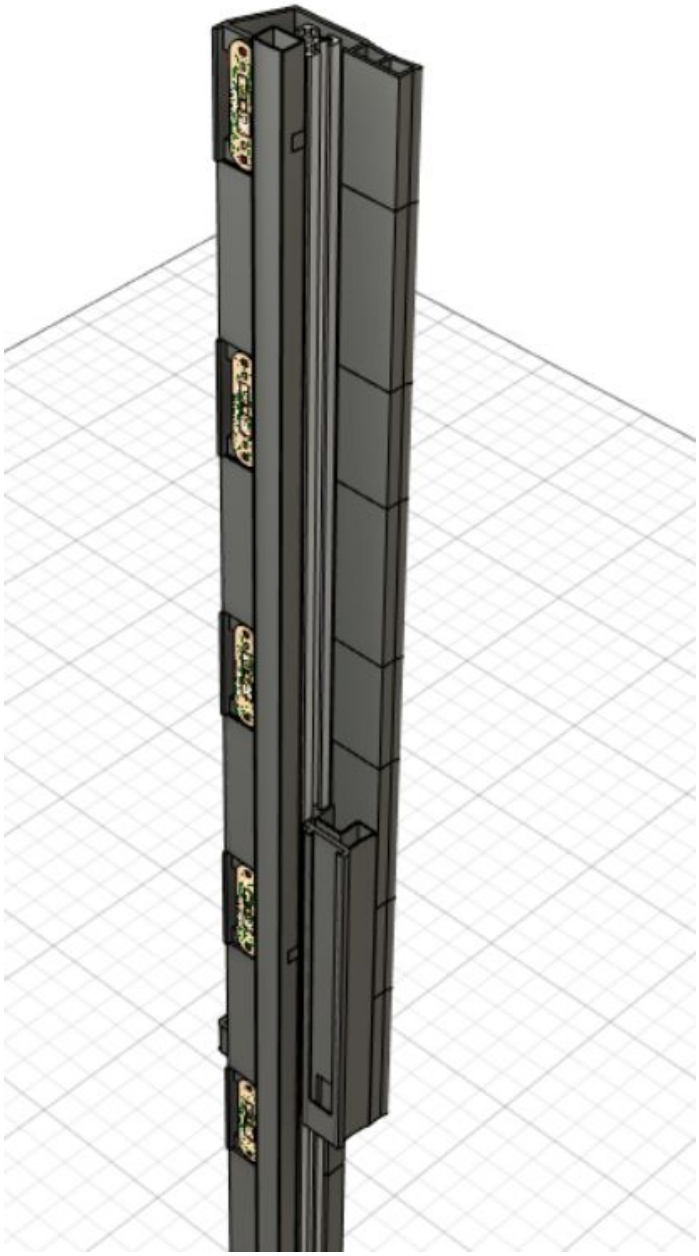
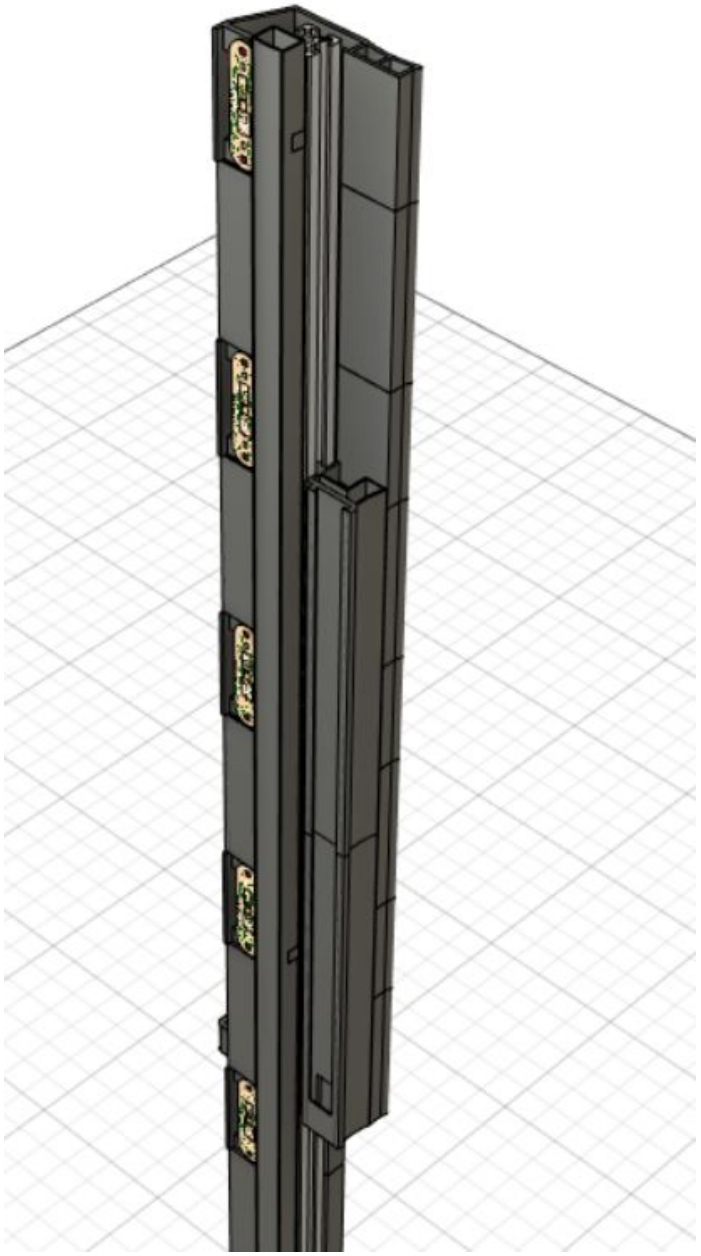
	
Slide on ZXGestureSensorMount2.1	Slide on SlidingWireManger2.1
	
Slide on ZXGestureSensorMount2.1	Slide on SlidingWireManger2.1

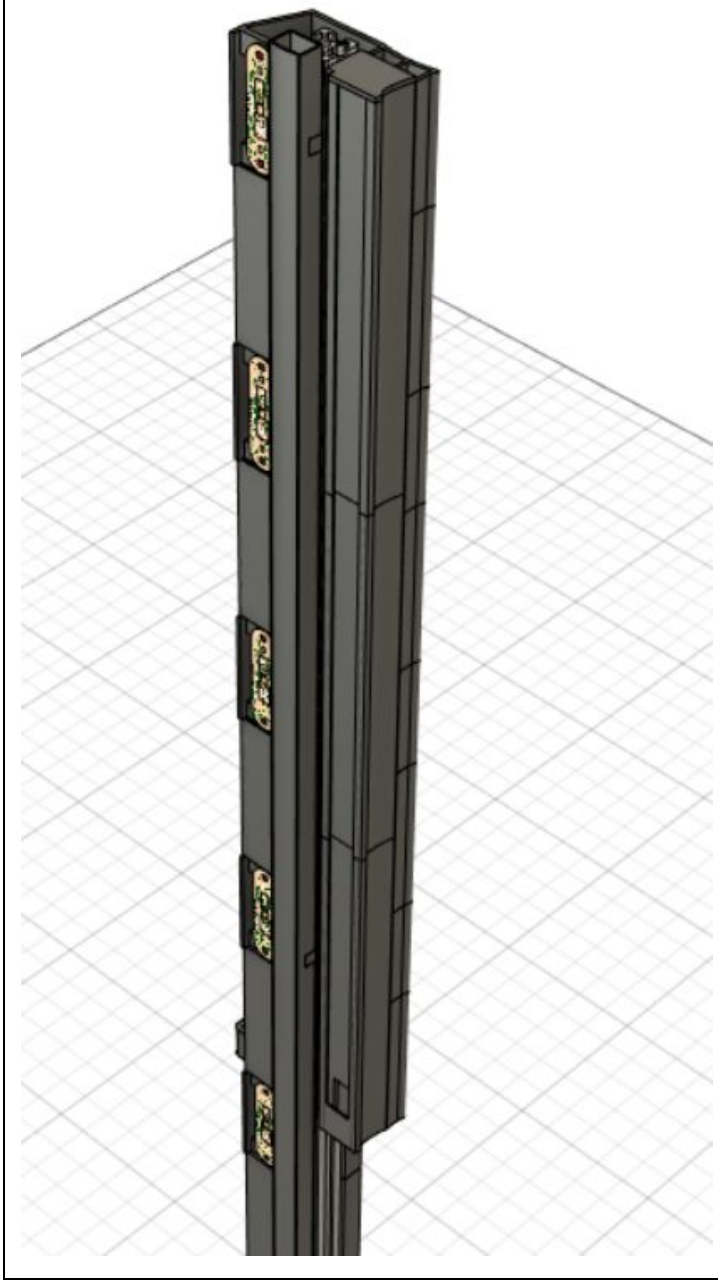


Slide on ZXGestureSensorMount2.1

Step 5

The fretboard holds the pressure and position sensors and is made up of 3 3D printed parts.

Slide on FretBoardBottom2.1	Slide on FretBoard2.1
	
Slide on FretBoardTop2.1	



Step 6

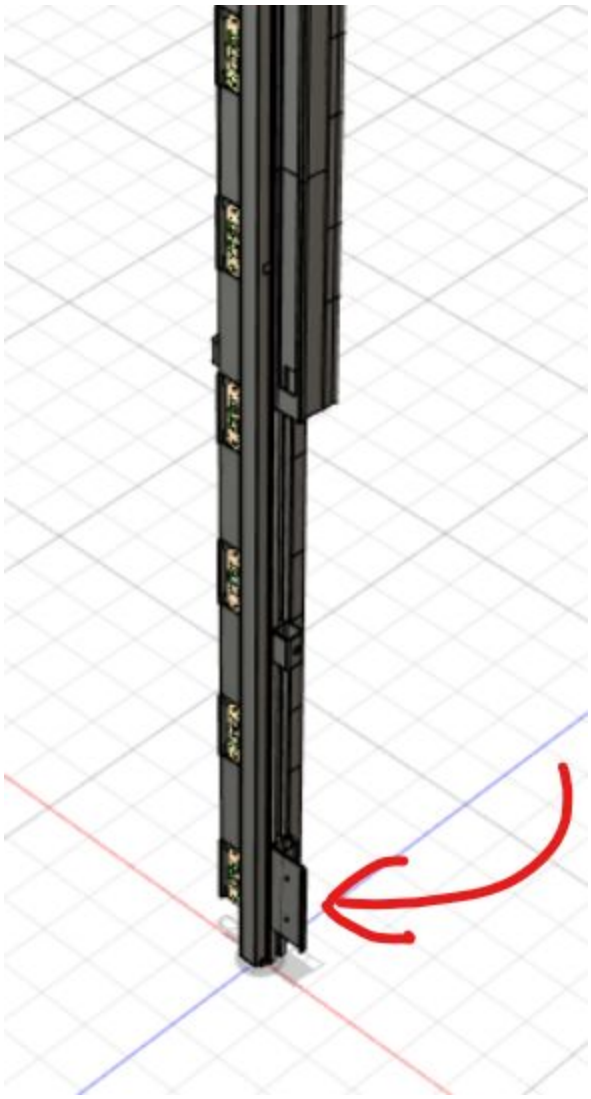
The fretboard has its wires managed by the FretBoardWireManager2.1. This brings wires down to the PCB, provides a secure place for the e-pick to dangle from, and is a way to secure parts vertically.

	Slide the FretBoardWireManager2.1 onto the board with a M3 Slide in T Nut, a 8 mm M3 x 0.5 mm screw, and an M3 washer attached to the middle of it as shown in the picture.

	Tighten down the screw once the wire manager is in place.

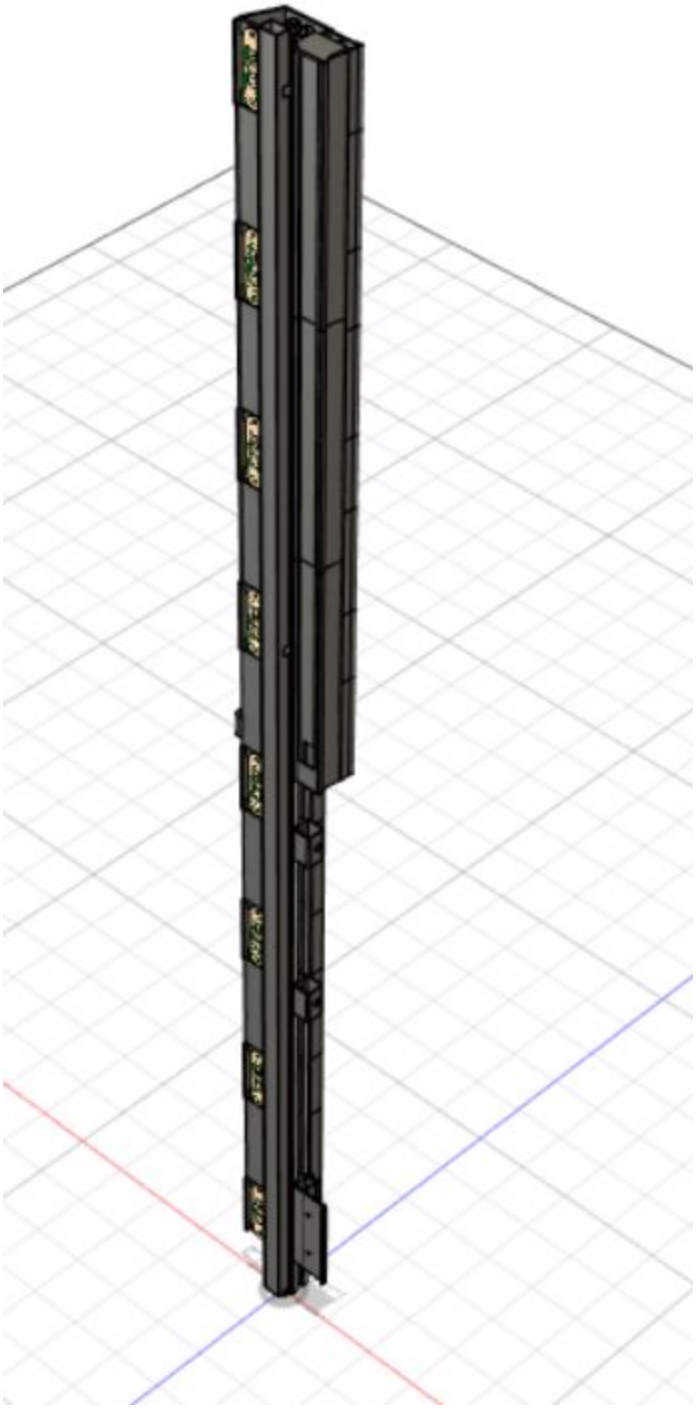
Step 7

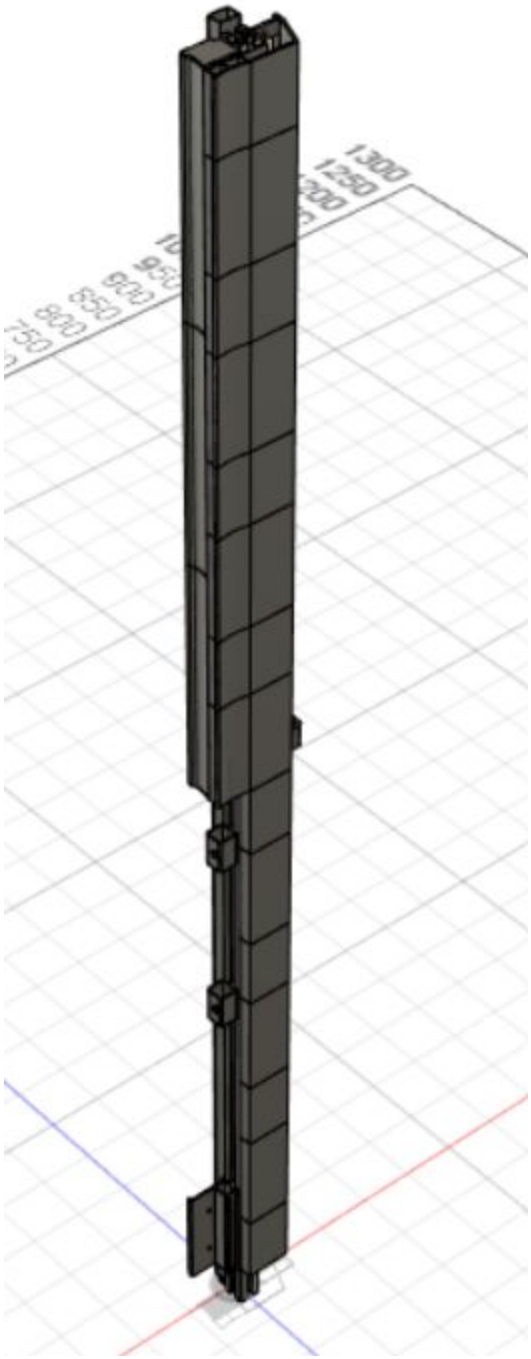
The PCBMount2.1 provides a method to attach the main PCB to the Optron. It can optionally be secured with sliding T nut.



Final

This is what the Optron should look like with all parts attached.





Sensors

todo.

PCB

1. Discrete Components
    a. Place resistors in appropriate locations
    b. Solder resistors
    c. Place capacitors in appropriate locations

    d. Solder capacitors
2. ItsyBitsy
    a. Solder headers for connection on M4.1, M4.2, and M4.3
    b. Place M4 ItsyBitsy on PCB
3. MPU6050
    a. Solder headers for connection on J.MPU
    b. Place MPU6050 on PCB
4. FSR
    a. Solder headers for connection on J.FSR
    b. Connect FSR to headers
5. Potentiometer
    a. Solder headers for connection on J.LN
    b. Connect potentiometer to headers
6. Flex sensor/pick
    a. Solder headers for connection on JPIC
    b. Connect flex sensor to headers
7. 5VDC Power
    a. Solder barrel jack to J.5VDC
    b. Solder jack or headers to J.5VDC2
8. Communication line
    a. Solder headers to J.DS
9. Quad Level Shifter
    a. Solder headers to 74A1 and 74A2
    b. Connect Quad Level Shifter to headers
10. Logic Level Converter
    a. Solder headers to sparkfun_logic_level_converter
    b. Connect logic level converter to headers
11. IR Multiplexer
    a. Solder headers to TCA.1 and TCA.2
    b. Connect the multiplexer to headers
12. Communication level shifter
    a. Solder headers to I2C.1.1, I2C.1.2, I2C2.1, and I2C2.2
    b. Connect BOB and shifter to headers

Programming

1. Download and install the latest version of the Arduino IDE

2. Start the IDE and navigate to File->Preferences (Windows/Linux), Arduino->Preferences (MacOS/OSX)

    a. Find "Additional Boards Manager URLs" dialog box and copy/paste the following url:

    https://adafruit.github.io/arduino-board-index/package_adafruit_index.json

    b. Click OK and restart the IDE

3. Install components

a. Install M4 board support for

i. Arduino SAMD Boards (32-bits ARM Cortex-M4+)

ii. Adafruit SAMD Boards

b. Install boards short instructions:

i. Open the Board Manager by navigating to Tools->Board->'Boards Manager'

ii. Install Arduino SAMD Boards Support (version 1.6.11 or later), by typing Arduino SAMD in the top search bar. Click install on the entry named "Arduino SAMD Boards (32-bits ARM Cortex-M4)

iii. Install Adafruit SAMD Package to add board file definitions. Type Adafruit SAMD or feather in the top search bar. Click install on the entry named "Adafruit SAMD Boards". The description of the package should mention support for feather M4 Itsy Bitsy

iv. Close the board's manager and restart the IDE

v. Navigate to Tools->Board, the Adafruit Feather M4 boards should be listed, select Adafruit Feather M4 Itsy Bitsy

vi. Install drivers if on Windows 7

4. Select Board

a. Set Board Profile to the Adafruit ItsyBitsy M4 (SAMD51)

i. Select: Tools > Board > Adafruit ItsyBitsy M4 (SAMD51)

b. Turn on Verbose output for Upload

i. PC: File > Preferences

ii. Mac: Arduino > Preferences

iii. Show Verbose output during: [check the upload box only]

iv. Plug in your Feather M4 Board

5. Connect a USB Micro Cable between your Feather M4 and computer USB port, then select your device via:

a. PC: Select: Tools > Port > COMx
b. Mac: Select: Tools > Port > Feather M4 Itsy Bitsy

6.Run the Blink Sketch to confirm configuration (optional)

a. Select: File > Examples > 01.Basics > Blink

b. Click the check-mark icon on the top-left of the IDE window to “Verify” the code compiles correctly. This may take a little while.
c. You should get a message saying: Sketch uses 10704 bytes (x%) of program storage space. Maximum is xxxxx bytes.

7. Manually bootloading

a. If you ever get in a 'weird' spot with the bootloader, or you have uploaded code that crashes and doesn't auto-reboot into the bootloader, click the RST button twice (like a double-click)to get back into the bootloader.
b. The red LED will pulse, so you know that it’s in bootloader mode.

   i. Once it is in bootloader mode, you can select the newly created COM/Serial port and retry uploading.

   Ii.You may need to go back and reselect the 'normal' USB serial port next time you want to use the normal upload.