<PLACE LOGO HERE>

Maker Component List

<Fill in the table below. Continue the labeling convention for other added parts. Copy the table for another sub-assembly, if required, and label the parts as B<PartNumber>.>

<Sub-Assembly Name>								
A01	<Part Name>	QTY: <#>	A02	<Part Name>	QTY: <#>	A03	<Part Name>	QTY: <#>
<INSERT IMAGE OF PART>			<INSERT IMAGE OF PART>			<INSERT IMAGE OF PART>		

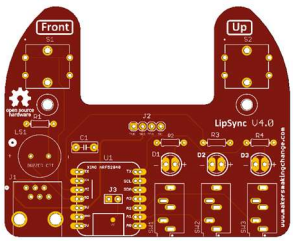
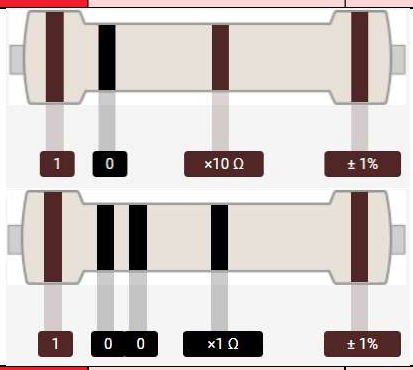
Assembly Guide

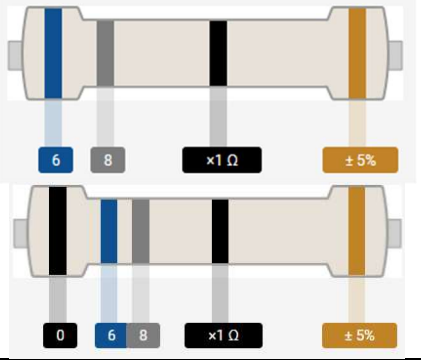
<Describe sub-assemblies and order of assembling them (if necessary)>.

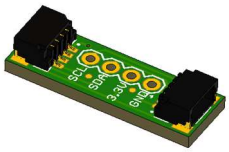
Assembly Section	
Part A: Hub PCB Assembly	<INSERT IMAGE OF SUB-ASSEMBLY>
Part B: Hub Enclosure Assembly	<INSERT IMAGE OF SUB-ASSEMBLY>
Part C: Joystick Assembly	<INSERT IMAGE OF SUB-ASSEMBLY> <remove this row if there is no firmware to be flased>
Part D: Flashing Firmware	

Part A: Hub PCB Assembly

Part A: Components

A1	LipSync 4 Hub PCB	QTY 1	**A2**	Capacitor, 10uF	QTY 1	**A3**	Resistor R1, 100 Ω, ¼ W, Through hole	QTY 1
								
A4	Resistor R2/R3/R4 68 Ω, ¼ W, Through hole	QTY 3	**A5**	Tactile Buttons S1/S2	QTY 2	**A6**	Piezo Buzzer PS1240	QTY 1

A7	Male Header, 4 position	QTY 1	**A8**	Sparkfun QWIIC Adapter	QTY 1	**A9**	Mono Switch Jacks	QTY 3
								
A10	RJ11 Modular Connector Jack	QTY 1	**A11**	SeeedStudio Xiao nrF52840	QTY 1	**A12**	Male Header, 7 position	QTY 2
								
A13	Headers, Female, 7 Position	QTY 2	**A14**	LEDs, 5mm though hole	QTY 3	**A15**	LipSync Hub LED Spacer	QTY 1
								

Part A: Tools

- Soldering iron
- Flush cutters
- Phillips Head Screwdriver
- OPTIONAL: Solderless Breadboard (For soldering male headers to microcontroller)

Part A: Personal Protective Equipment (PPE)

- Safety glasses

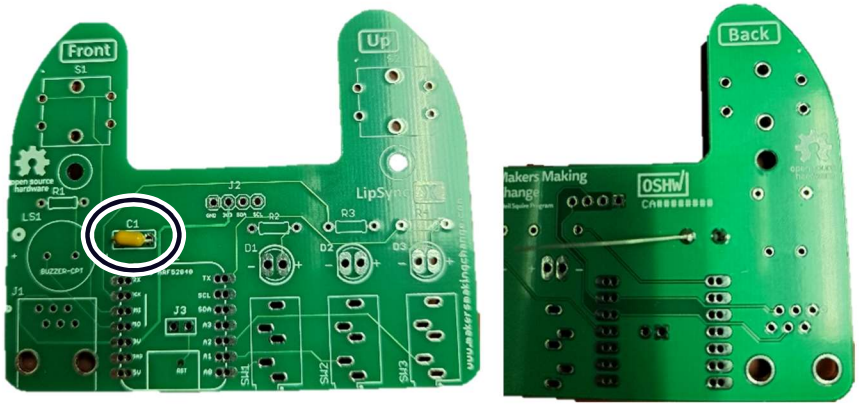
Willow Joystick
MAKER GUIDE

Part A: Hub PCB Assembly Steps

Note that all parts will be inserted onto the side of the PCB labeled “Front”, and all soldering will be done on the side labeled “Back”.

Step A-01: Solder in 10 micro Farad capacitor, C1.

Insert the 10 micro-Farad capacitor (A2) into the position labeled C1 on the PCB (A1). Bend the leads of the capacitor to the side to hold it in place. Solder the capacitor onto the PCB. Once soldered, trim the extra from the leads.

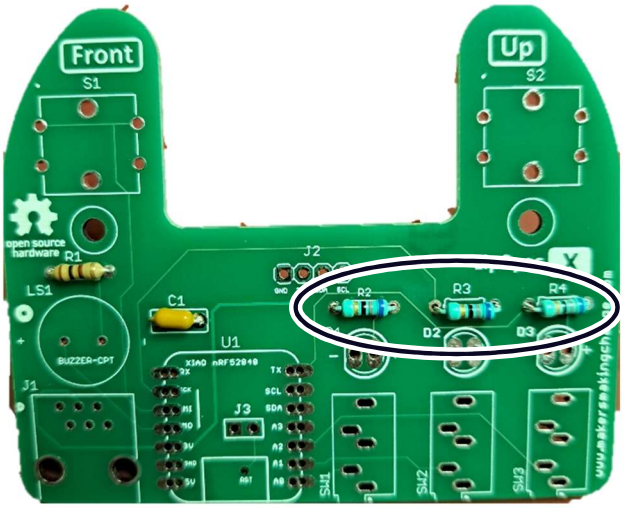


Step A-02: Solder in 100 Ohm resistor, R1.

Insert the 100 Ohm resistor (A3) into the position labeled R1 on the PCB. Bend the leads of the resistor to the side to hold it in place. Solder the resistor onto the PCB. Once soldered, trim the extra from the leads.

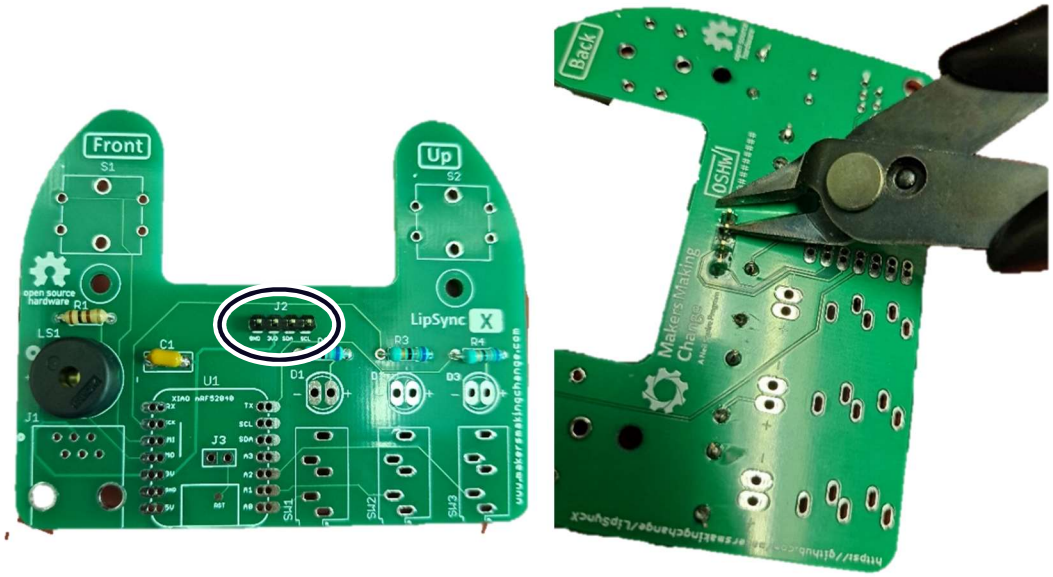
Step A-03: Solder in 68 Ohm resistors, R2, R3, and R4.

Insert the 68 Ohm resistors (A4) into the positions labeled R2, R3, and R4 on the PCB. Bend the leads of the resistors to the side to hold them in place. Solder the resistors onto the PCB. Once soldered, trim the extra from the leads.



Step A-04: Insert, solder, and trim the 4-pin Male header.

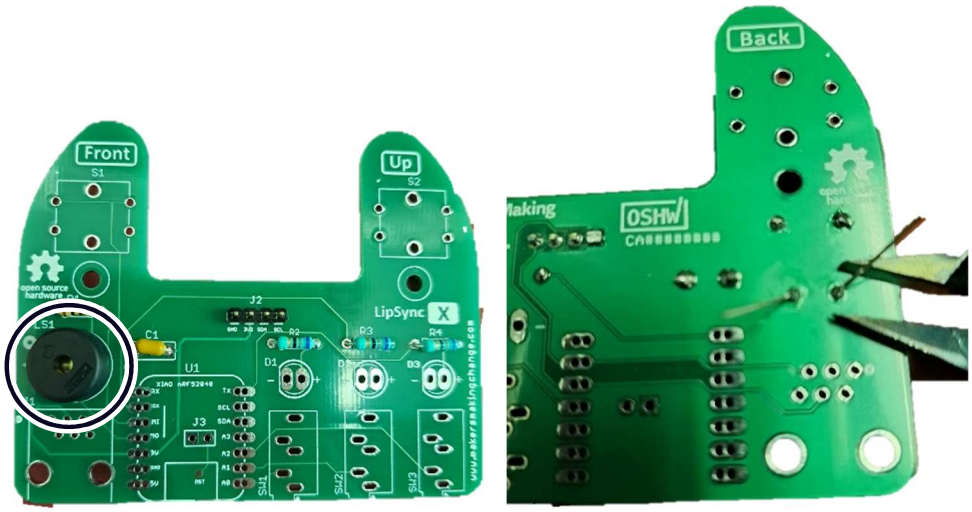
Insert the longer pins of the 4-pin male header (A7) into the position labeled J2. Solder it into place and trim the excess from the bottom.



Step A-05: Insert, solder, and trim buzzer.

Insert the buzzer (A6) into the position labeled LS1. If using a buzzer with polarity, make sure the positive lead is in the hole marked with a "+" on the PCB. Note that the Piezo Buzzer PS1240 does not

have polarity. Bend the leads to the side to hold the buzzer in place. Solder in place and trim excess from the leads.

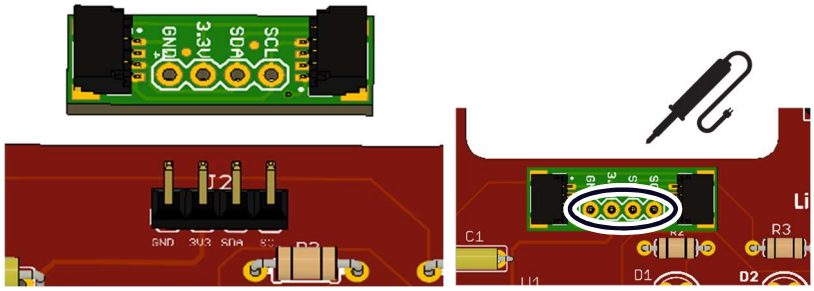


Step A-06: Insert, solder, and trim switches.

Insert the two tactile switches (A5) into the positions labeled S1 and S2. Once soldered in place, trim any excess from leads of the switches.

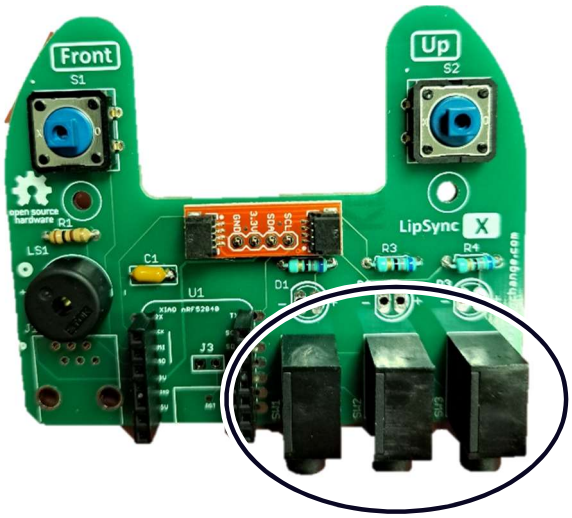
Step A-07: Insert and solder SparkFun QWIIC Adapter.

Place the SparkFun QWIIC Adapter (A8) on the 4-pin male header (A7) that was attached to J2 in step A-04. Ensure the pin labels on the adapter matches the pin labels on the Hub PCB. Solder the four pins on the adapter.



Step A-08: Insert and solder switch jacks.

Insert the switch jacks (A9) into the positions labeled SW1, SW2, and SW3. Solder one pin on each switch jack, then check the alignment. If the alignment needs to be changed, reheat the solder joint until the solder melts, then reposition the jack. Once the jacks are positioned properly, solder the remaining pins.

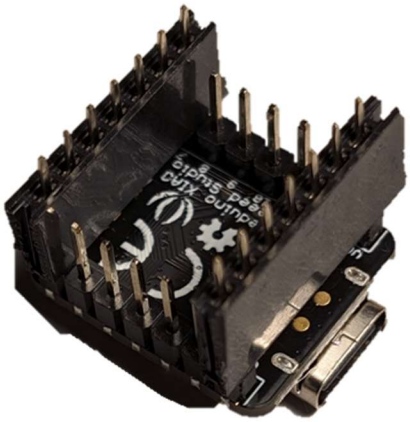


Step A-09: Solder male headers onto microcontroller.

Insert the short side of the male headers (A12) into the SeeedStudio Xiao nrf52840 microcontroller (A11) from the bottom of the board. To align the male headers and keep them straight when soldering, take the 7-position female headers (A13), and insert the male headers into the female headers across the microcontroller (as shown in the picture on the left).

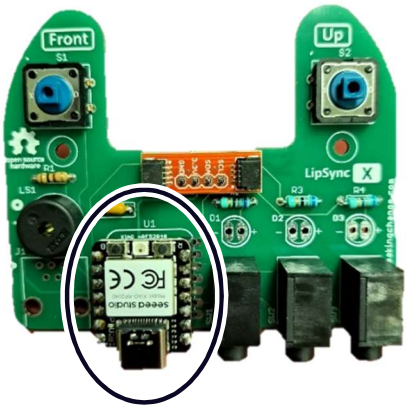
Alternatively, a solderless breadboard can be used, plug the unsoldered microcontroller and headers into the protoboard and the protoboard will hold the headers in the proper alignment.

Solder the male headers onto the microcontroller, making sure not to connect adjacent pads together with solder. Once soldered, remove the 7-pin female headers from the male headers.



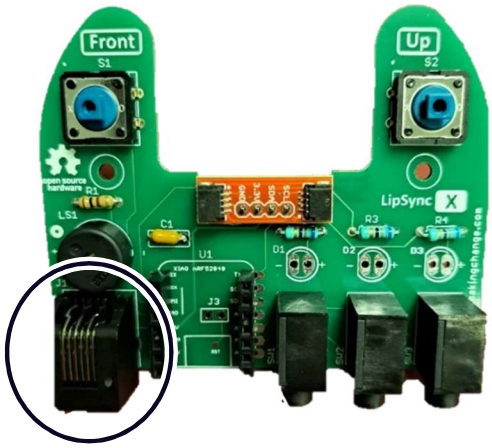
Step A-10: Solder female microcontroller header into PCB.

Insert microcontroller with male headers into the female headers (A13). Insert the female headers into PCB. Solder 1 pin on each header. Check alignment and adjust if necessary. If you need to adjust the alignment, heat the single soldered pin until the solder melts again and adjust the position of the row of headers. Once aligned, solder remaining headers.



Step A-11: Insert and solder the RJ11 jack.

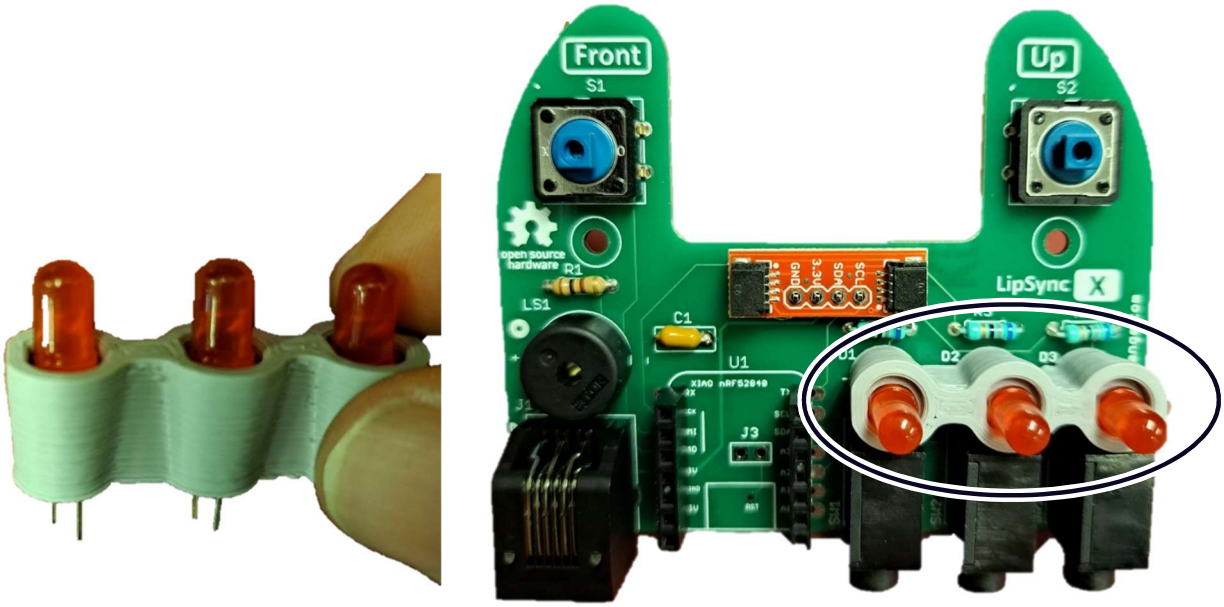
Insert the RJ11 jack (A10) into the position labeled J1 on the PCB. Solder the six pins into place.



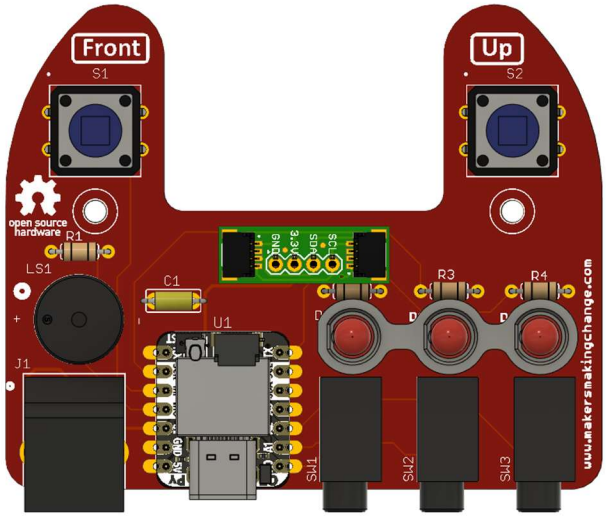
Step A-12: Insert, solder, and trim LEDS.

Insert the three LEDs (A14) into the 3D printed LED Spacer(A15). Ensure the shorter lead of the LED (the negative lead) is on the same side as the flat edge of the LED Spacer. The LED will also have a flat edge matching the flat edge on the spacer.

With the LEDs inserted into the spacer, insert the LEDs into the matching holes in the PCB. The flat side of the LED spacer should be on the left with the rounded side on the right, when looking at the PCB from the front. Solder the LEDs in place and trim the excess from the leads.

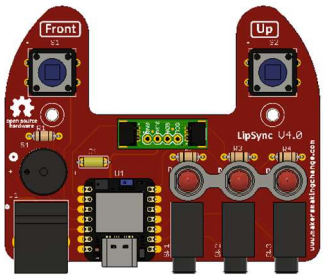
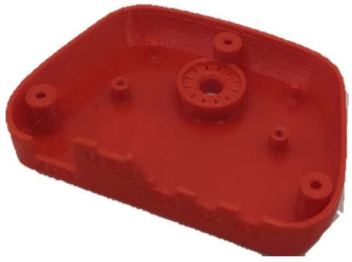


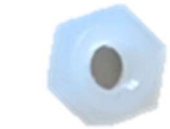
Willow Joystick
MAKER GUIDE
Part A Complete



Willow Joystick
MAKER GUIDE
Part B: Hub Enclosure Assembly

Part B: Components

B1	Populated LipSync 4 Hub PCB	QTY 1	**B2**	STEMMA QT Cable – 100 mm	QTY 1	**B3**	OLED Display	QTY 1
								
B4	LipSync Hub Enclosure Top	QTY 1	**B5**	LipSync Next Button Pusher	QTY 1	**B6**	LipSync Select Button Pusher	QTY 1
								
B7	LipSync Hub Enclosure Bottom	QTY 1	**B8**	Screw, #4, 3/8” Length	QTY 5	**B9**	M2.5 Machine Screw, 8 mm	QTY 4
								

B10	M2.5 Nut	QTY 4	**B12**	T-Nut	QTY 1	**B13**	Light Pipe	QTY 1
								

Part B: Tools

- Phillips Head Screwdriver

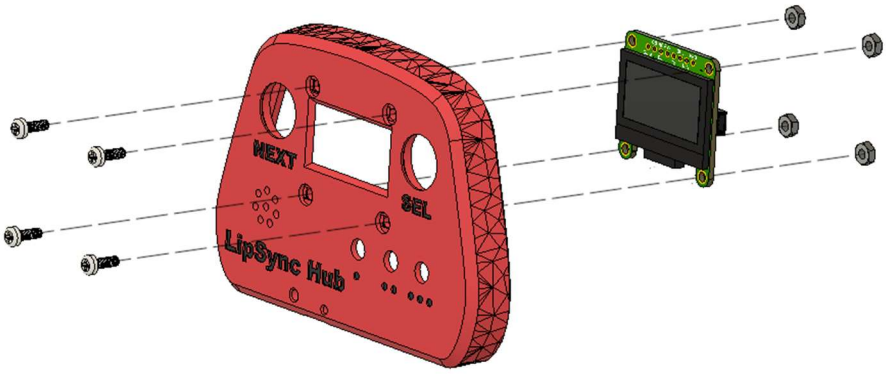
Part B: Personal Protective Equipment (PPE)

- Safety glasses

Part B: Assembling Hub Enclosure Steps

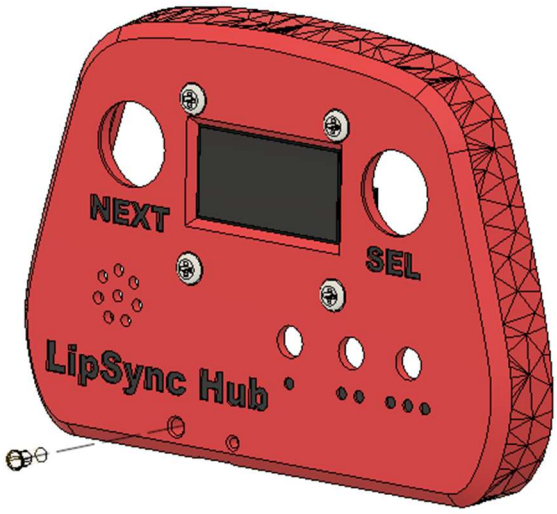
Step B-01: Connect Display to LipSync 4 Hub Enclosure Top

Peel off the protective film on the Display (B3) and connect it to the Hub Enclosure Top (B4) using four nylon M2.5 machine screws (B9) and four nylon M2.5 hex nuts (B10). Do not overtighten.



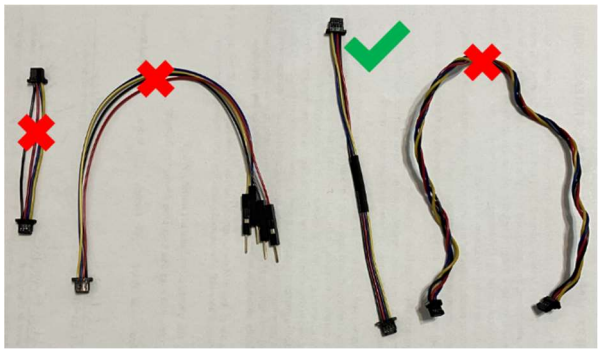
Step B-02: Insert the Light Pipe

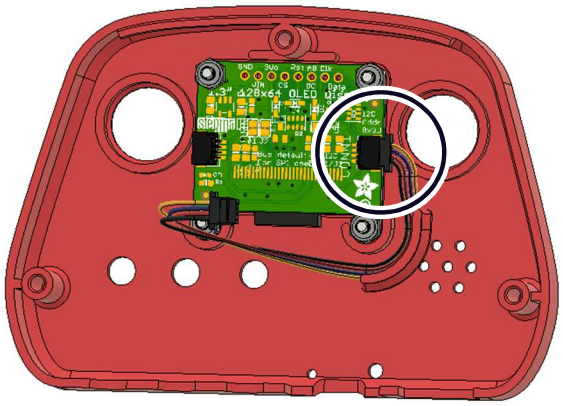
From the front side, insert the **light pipe** (B13) into the Hub Enclosure Top.



Step B-03: Connect STEMMA / QWIIC Cable to Display

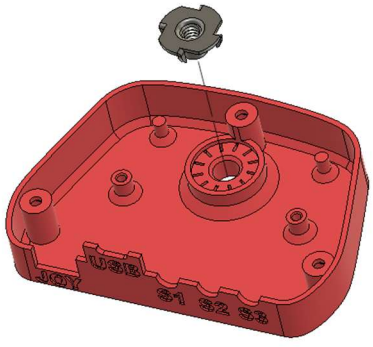
Flip the Hub Top over so the Display is facing down. Connect the 100 mm STEMMA/QWIIC cable (B2) to the port on the right-hand side of the Display as shown. Ensure the holes for the pins in the cable line up with the pins in the port on the PCB. Do not connect the second end of the STEMMA/QWIIC cable to the second port on the screen.





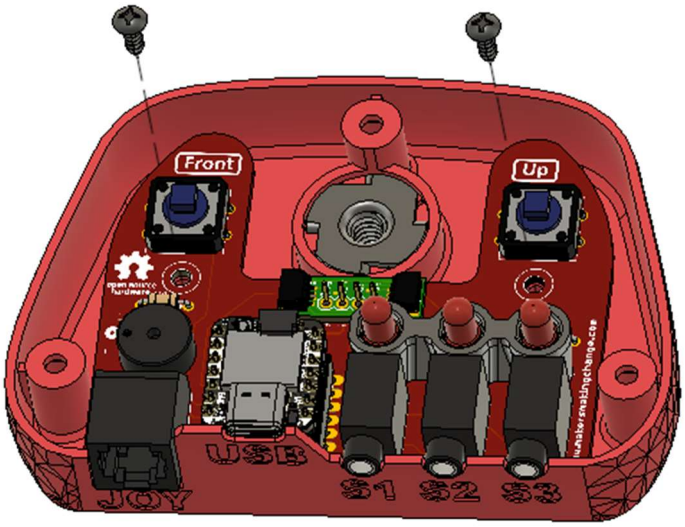
Step B-04: Insert the Tee Nut into the Hub Bottom

Insert the tee nut (B12) into the slots inside the Hub Bottom. A ¼” machine screw or hex bolt can be used to tighten the Tee Nut into place. The nut should sit flush with the enclosure.



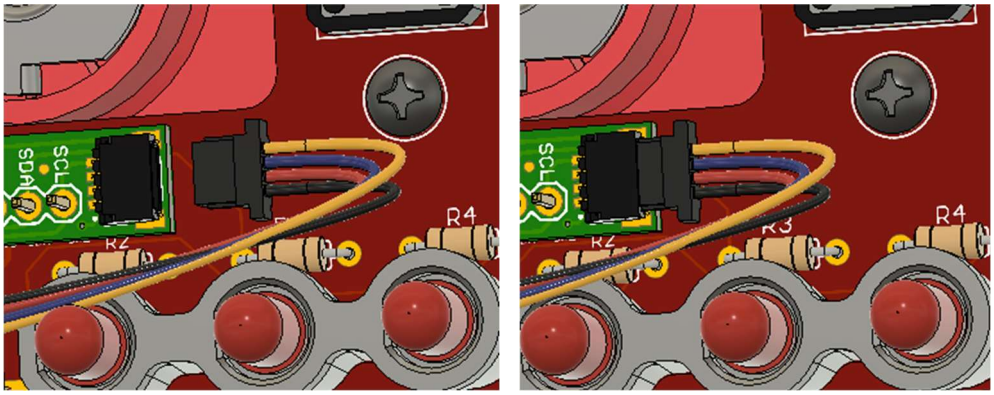
Step B-05: Secure LipSync Hub PCB into Hub Bottom

Use two #4 sheet metal screws (B8) to secure the PCB (A1) into the Hub Bottom.



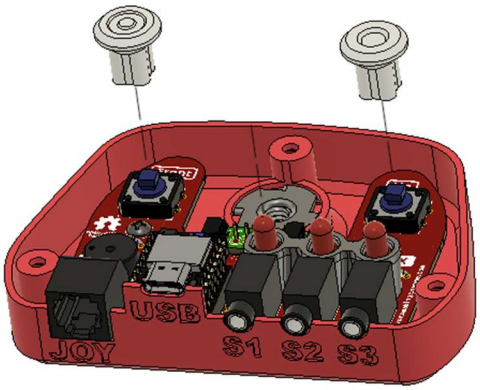
Step B-06: Connect the STEMMA / QWIIC Cable to the QWIIC Adapter on the PCB

Connect the 100 mm STEMMA/QWIIC cable from the display to the QWIIC adapter on the PCB. Again, ensure the holes for the pins in the cable line up with the pins in the port on the PCB.



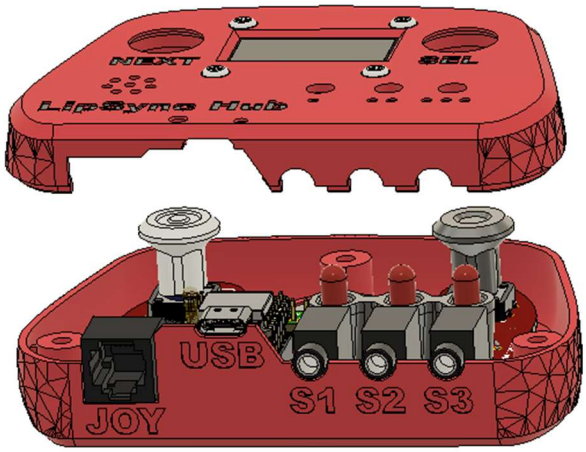
Step B-07: Place the Button Pushers on top of the Buttons

Position the Select Button (B6) and the Next Button (B5) on top of the Buttons on the PCB. The Next Button goes on the left button and has a target shape on the front. The Select Button goes on the right button and has a ring printed on the front.



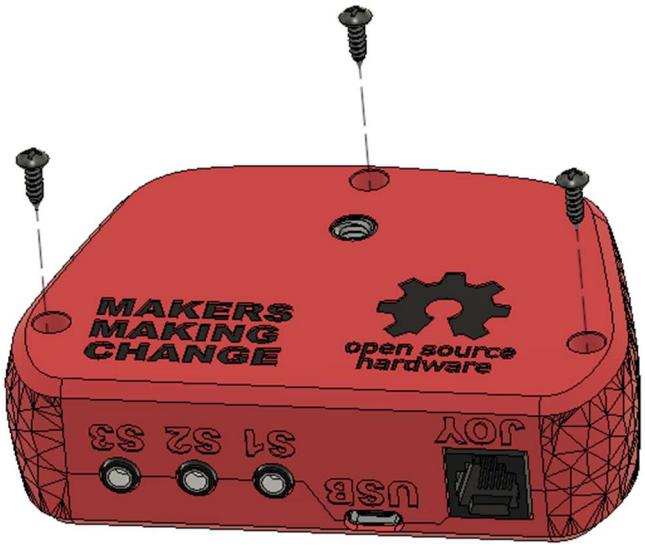
Step B-08: Position the Hub Top on to the Hub Bottom

Position the Hub Top onto the Hub Bottom, making sure to align the Button Pushers and their LEDs with the corresponding hole.

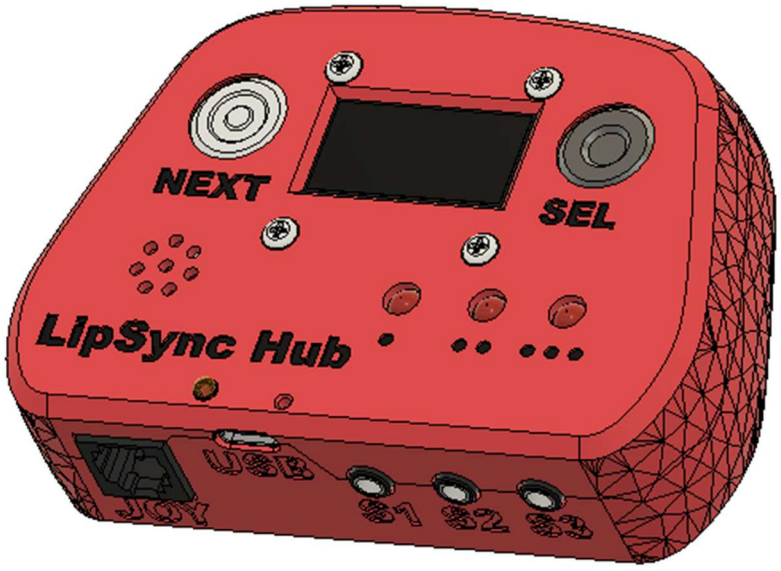


Step B-09: Secure the Hub Top and Hub Bottom

Carefully turn the Hub over. Use a #4 sheet metal screw(B8) in each of the three holes to secure the two parts together.



Part B Complete



Part C: Joystick Assembly

Part C: Required Components

<Copy and paste the second sub-assembly table from the Maker Component List section>.

Part C: Required Tools and Supplies

<Add a bullet list of the required tools and supplies for this sub-assembly>

-
-

PartC: Required Personal Protective Equipment (PPE)

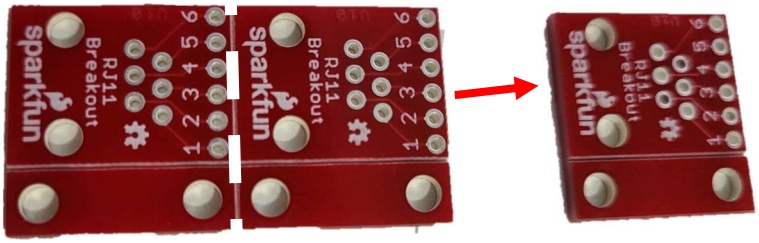
<Add a bullet list of the required PPE for this sub-assembly>

-
-

Part C: Joystick Assembly Steps

Step C -01: Snap the breakout boards

Separate the two RJ11 breakout boards (E9) by snapping them apart by hand. Snap off the thin portion with the two mounting holes.

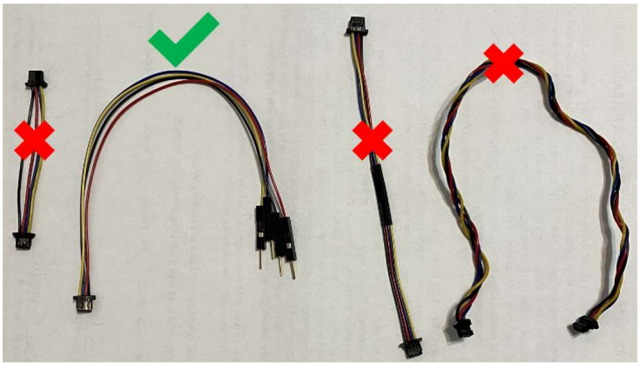


Step C-02: Solder the RJ11 jack to the RJ11 Breakout Board

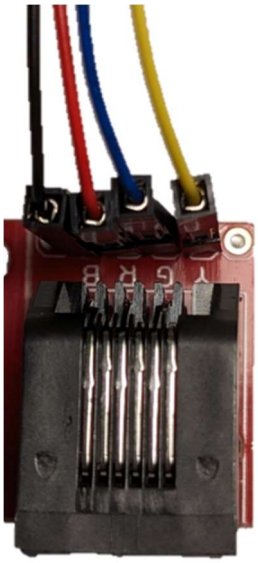
Press the RJ11 Jack (E8) into the breakout board so the pins stick out of the numbered side. Solder the six RJ11 pins poking through the board, **NOT THE NUMBERED HOLES.**

Step C-03: Solder the STEMMA QT Cable to the RJ11 Breakout Board

Insert the DuPont headers on the Stemma-Dupont connector (E7) into the through holes on the RJ11 Breakout Board from the same side as the RJ11 Connector, following the order in the table. Solder in place, and trim the DuPont ends sticking out the back side.



RJ 11 Breakout	STEMMA QT Cable
2 (B)	Black (Gnd)
3 (R)	Red (Vcc)
4 (G)	Blue (SDA)
5 (Y)	Yellow (SCL)

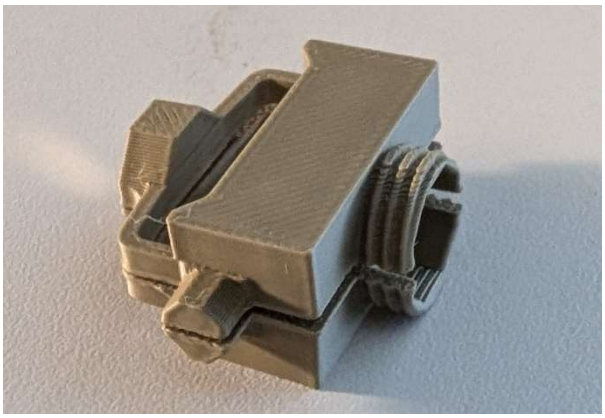


Step C -04: Insert the Magnets

Press an M2.5 nut and two magnets into one of the inner gimbal prints. Make sure that the magnets are oriented the same direction so that they attract each other and not repel.

Step C -05: Attach second half of inner gimbal

Press the second half of the inner gimbal onto the first and squeeze it tight



Step C -06: Attach inner gimbal bearings

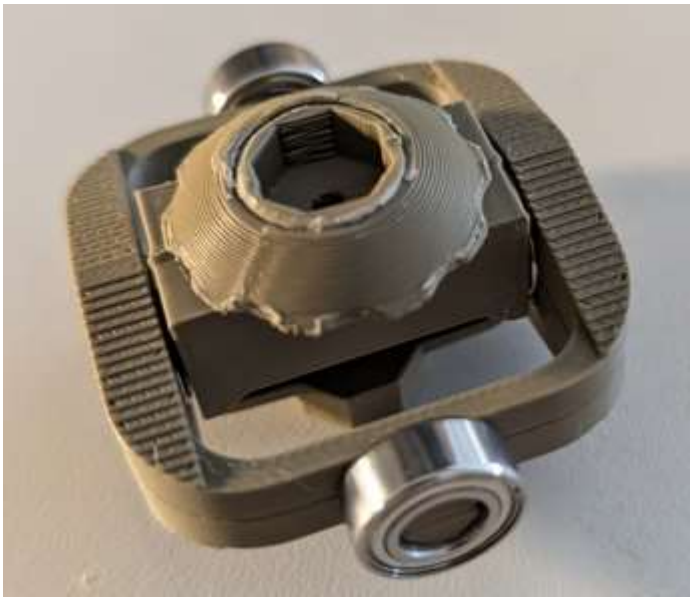
Push bearings onto posts

Step C-07: Attach the Gimbal Shield

Screw the gimbal shield onto the threads on the inner gimbal

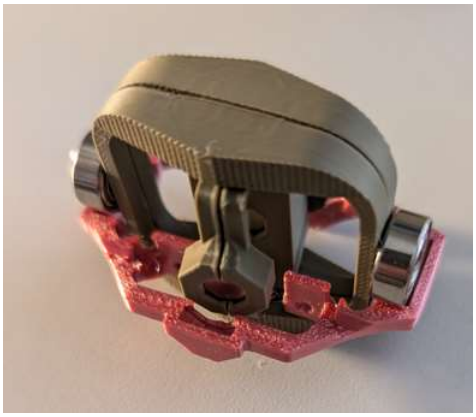
Step C -08: Add Outer Gimbal

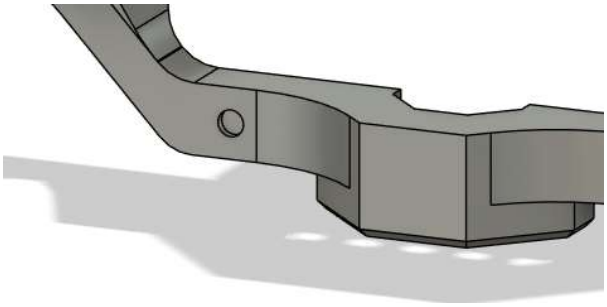
Take both halves of the outer gimbal and press them around the inner gimbal. Add the bearings on the bearing posts to secure them in place. It does not matter if outer gimbal 1 or 2 is up.



Step C -09: Press Gimbal into Sled

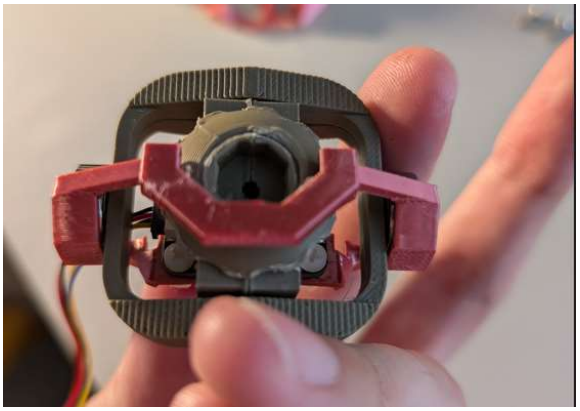
Press the gimbal into the sled 1 piece, marked by a single dot by the bottom magnet piece with the magnet facing the bottom

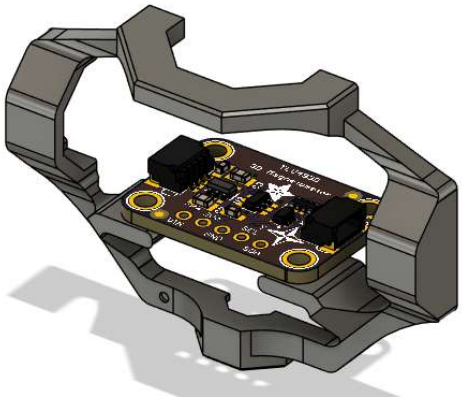




Step C-10: Insert Magnetic Sensor

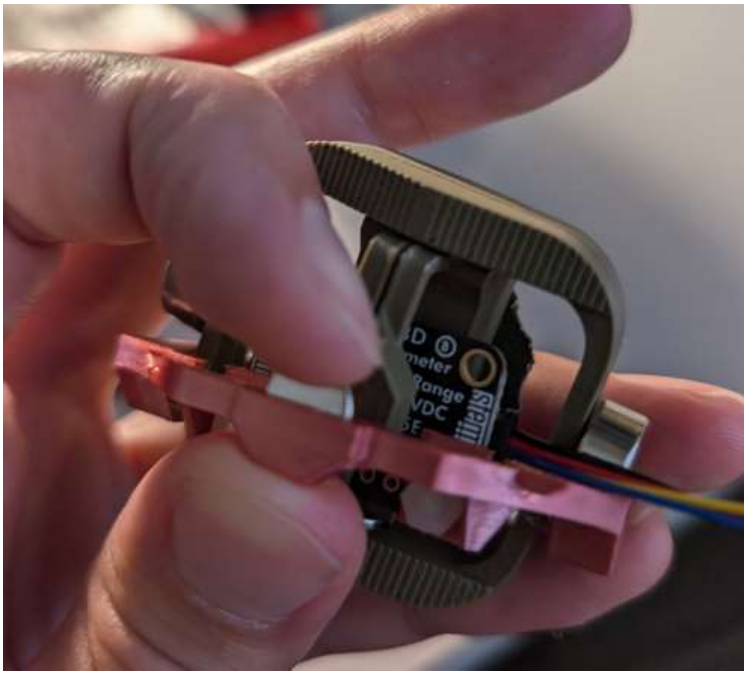
Insert the magnetic sensor between the two magnets on the inner gimbal, and use 2 of the M2.5 bolts and nuts to secure it in place. When inserting the sensor, have the pins facing the sled 1 side Plug in the stemma cable to the side with the notch for cable management.





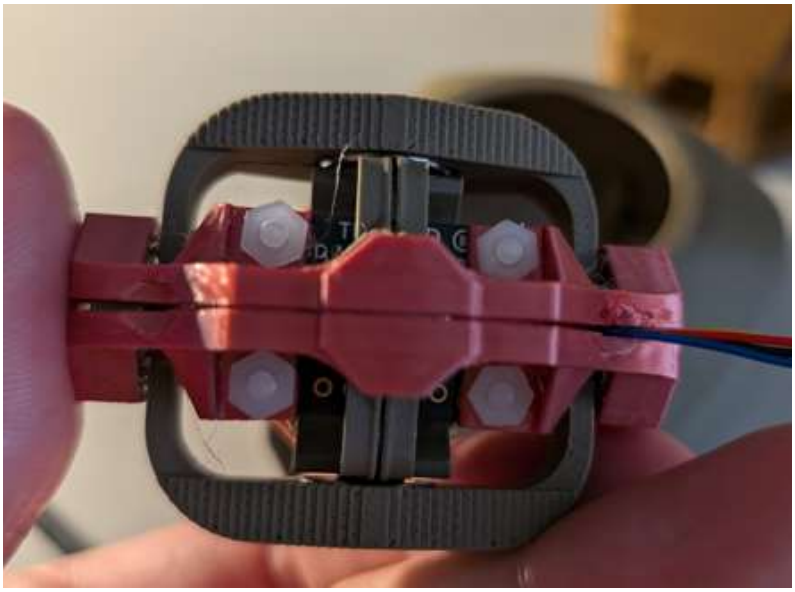
Step C -11: <Step Summary>

Press a magnet into the slot on the base of the sled. Make sure it matches the orientation of the other magnets, so that the gimbal is attracted to the base instead of repelled.



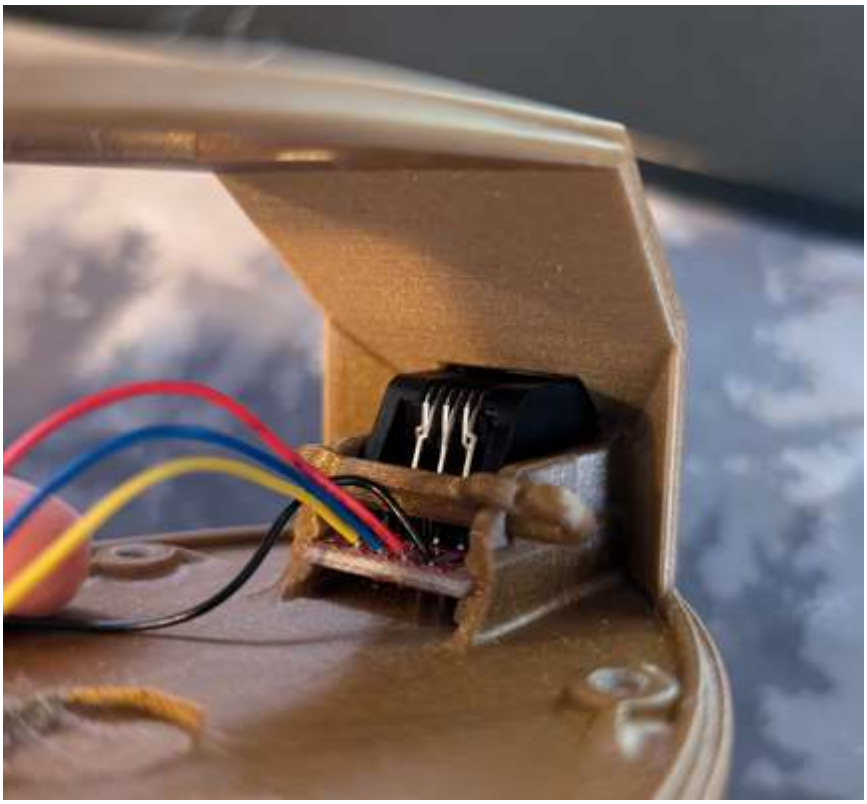
Step C -12: Attach Second Half of Gimbal

Press the other half of the gimbal into place so that the magnet is fully captured. Use two of the M2.5 bolts and nuts through the magnetic sensor to secure the second half of the gimbal in place.



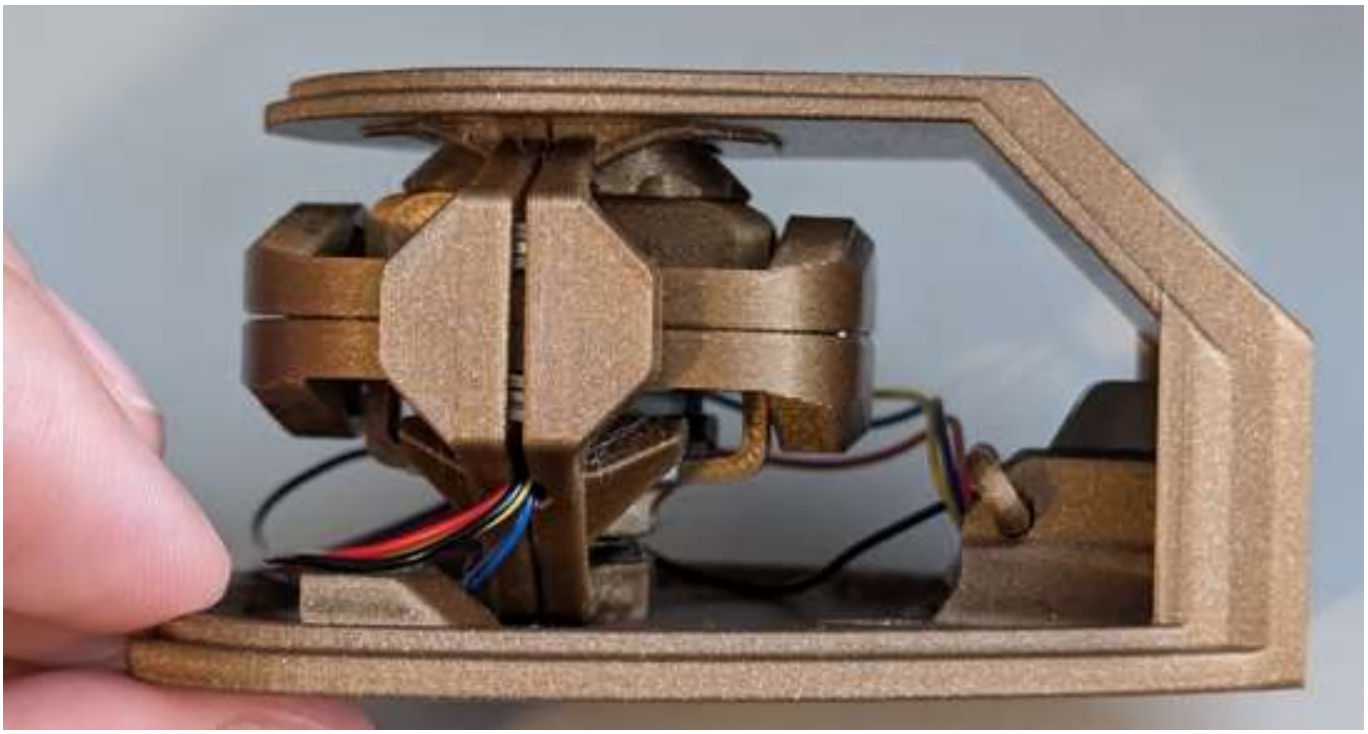
Step C-13: Attaching the RJ11 Jack

Slide the RJ11 jack into the base and secure it with the pin.



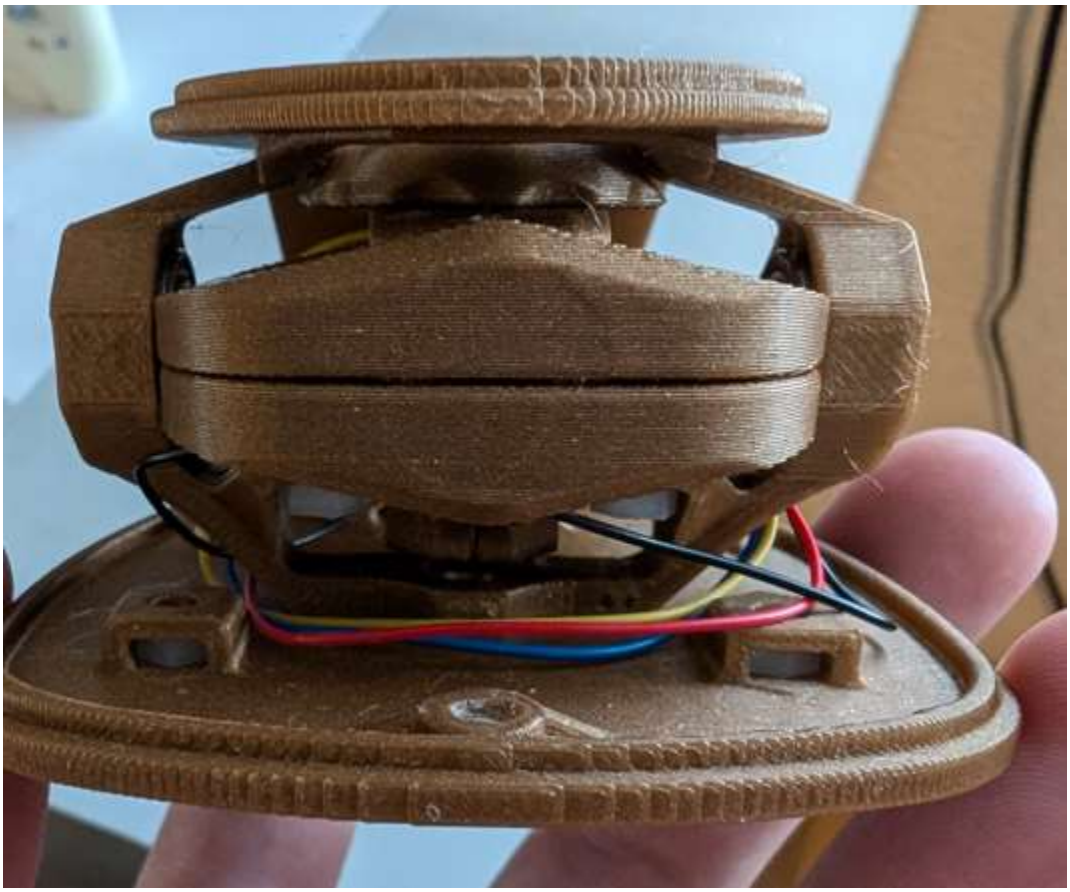
Step C-14: Insert the Gimbal

Slot the gimbal into the base, with the top and bottom of the gimbal fitting in the octagons on the top and bottom of the base. Wind the cable around the gimbal.



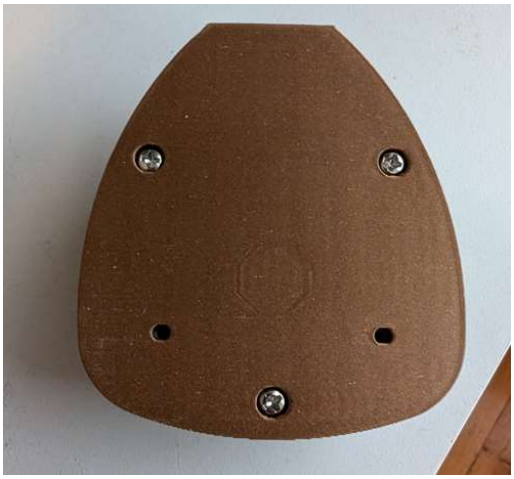
Step C -15: Attach Mounting Nuts

Push the M3 nuts into the slots in the base



Step C-16: <Step Summary>

Attach the shell with 3 #4 sheet metal screws. Be careful to not pinch the cables when attaching the shell.



<PLACE LOGO HERE>

Willow Joystick
MAKER GUIDE
Part D: Flashing Firmware to Willow

Part C: Required Components

<Copy and paste the firmware sub-assembly table from the Maker Component List section>.

Part C: Required Tools and Supplies

<Update the bullet list with any tools and supplies required>

- Computer that is able to install Arduino IDE and other Arduino libraries to flash firmware

Step C-01: Connect the LipSync Joystick To The Hub

Plug in the Joystick (F1) to the Hub (F2) using the RJ 11 (F3) Cable.

Step C-02: Connect the LipSync Hub to the Computer

Plug in the Hub (F2) to a computer via USB Cable (F4).

Step C-03: Setup Arduino IDE on Computer

1. Download Arduino IDE for your operating system at https://www.arduino.cc/en/software
2. Install the Arduino IDE.

Step C-04: Setup Arduino IDE for Seed Studio Xiao nRF52840 Development Board

1. Open Arduino IDE.
2. Click on **File -> Preferences**.
3. Locate the text field that says **Additional Boards Manager URLs** beside it.
4. Copy and paste the following link into the field as a new line:

   https://files.seeedstudio.com/arduino/package_seeeduino_boards_index.json

3. Click on **OK.**
5. Restart the Arduino IDE.
6. Open the **Boards Manager** option from the **Tools-> Board-> Boards Manager...,**
7. Search for “Seeed nrf52” and select “Seeed nRF52 Boards” by Seeed Studio.
8. Click **Install** to install the board.

Step C-05: Install Libraries

1. In the Arduino IDE, go to **Tools -> Manage Libraries…**
2. For each of the libraries in the table below, search for the name, and click Install. If prompted to install any dependent libraries, click OK.

Name	Author	Version
Adafruit_SSD1306	Adafruit	2.5.9 or later
ArduinoJson	Benoit Blanchon	7.0.4 or later
TLV493D-A1B6	Infineon Technologies	1.0.3 or later

Adafruit_TinyUSB	Adafruit	**2.3.0**

IMPORTANT	Use Adafruit Tiny USB Library version 2.3.0. Later versions will not currently work – a longer term fix is in progress.

Step C-06: Setup Local Code Directory

1. Download the Firmware_Files from the GitHub Repository: https://github.com/makersmakingchange/LipSync/blob/main/Build_Files/Firmware_Files/LipSync_Firmware.zip
2. Extract / unzip the folder to a known location.
3. Confirm that you have the following folder structure:
   - LipSync_Firmware (folder)
     - Willow_Firmware.ino
     - LSAPI.ino
     - LSTest.ino
     - LSBLE.h
     - LSBuzzer.h
     - LSCircularBuffer.h
     - LSConfig.h
     - LSInput.h
     - LSJoystick.h
     - LSMemory.h
     - LSOutput.h
     - LSScreen.h
     - LSTimer.h
     - LSUSB.h
     - LSUtils.h

Step C-07: Upload the Code to the microcontroller.

1. Open Willow_Firmware.ino with Arduino IDE.
2. Select **Seeed Xiao NRF52840** from **Tools -> Board -> Seeed NRF52 Boards**
3. Connect the LipSync using the USB cable to the computer.
4. Select the correct port from **Tools -> Port** menu.
5. Verify and upload the code.

Testing

<Explain any testing the maker will have to complete to make sure the device is working properly>

<PLACE LOGO HERE>

Troubleshooting

<Include any common errors / issues the maker may encounter and suggestions how to solve them.>