

Forest Joystick Mouse Hub

MAKER GUIDE

Overview

This document contains the necessary information to build the device.

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Maker Checklist

This list provides an overview of the steps required to build and deliver the device.

Maker To Do List

- ☐ Read through the Assembly Guide to become familiar with required components, tools, supplies, and safety gear and overall assembly steps.
- ☐ Talk to User about customization options (e.g., colour, any special requests, etc.)
- ☐ Ask user if any assistive switches are required.
- ☐ Ask user if any analog joysticks are required.
- ☐ Estimate cost of materials
- ☐ Order the custom PCB
- ☐ Order hardware components
- ☐ Print or obtain the 3D prints
- ☐ Gather tools, supplies, and safety equipment.
- ☐ Assemble the device
- ☐ Test device
- ☐ Print "User Guide"

Items to Give to User

- ☐ Assembled, tested device
- ☐ "User Guide"

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Tool List

1. Soldering iron
2. Flush cutters
3. Phillips Head Screwdriver
4. Computer with USB port and Arduino IDE (or ability to install it)

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Customization Guide

The device can be printed in the user's desired color.

Contrasted Labels

A layer change can be done for the top and bottom enclosure to make the labels have greater contrast.

Colored Labels

If you have access to a suitable multiple extruder or multiple color 3D printer, the labels can be printed in multiple colors.

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Custom PCB Guide

The Forest Hub uses one (1) custom circuit board.

The Custom PCB can be ordered from one of a variety of PCB Manufacturers. Typically, the minimum quantity for a custom PCB is five. Shipping options vary significantly in cost and shipping time. Plan on at least a week from the time of order to the PCBs arrival.

Ordering the Custom PCB

1. Select a PCB Fabrication Company
 - a. [JLPCB](#)
 - b. [PCBWay](#)
 - c. [OSH Park](#)
 - d. [Seeed Fusion PCB](#)
2. Create an account or use a guest login.
3. Upload the Gerber Files (e.g., Forest-Joystick-Mouse-Hub_YYY-MM-DD.zip).
4. Select the fabrication options:
 - a. PCB Layers: 2 Layers
 - b. PCB Quantity: 5
 - c. PCB Thickness: 1.5 mm
 - d. Surface Finish: HASL
 - e. PCB Color: Choose what you like. Note that certain colors may impact build time.
 - f. The default settings for the other settings should work.
5. Select shipping option.
 - a. Shipping options and costs vary significantly. Select the best option based on your budget and timing.
6. Submit the order.

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3D Printing Guide

3D Printing Summary

Metrics	Single Unit
Total Print Time (min)	3h52m
Total Number of Components	3
Typical Total Mass (g)	40
Typical Number of Print Setups	1

3D Printing Settings

Print File Name	Qty	Total Print Time (hr:min)	Mass (g)	Infill (%)	Support(Y/N)	Layer Height/ Nozzle Diameter(mm)	Notes
Forest_Hub_Top.stl	1	2:40	24	15	N	0.2/0.4	
Forest_Hub_Bottom.stl	1	0:51	13	15	N	0.2/0.4	
Forest_HUB_LED_Spacer.stl	1	0:20	3	15	N	0.2/0.4	

Post-Processing

- Remove any stringing or blobs

Examples of Quality Prints



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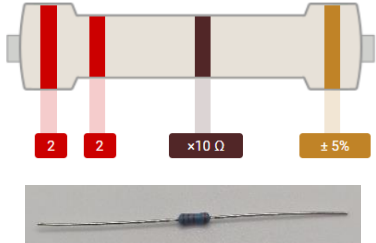
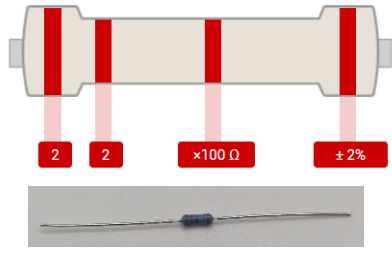
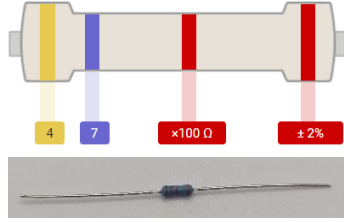
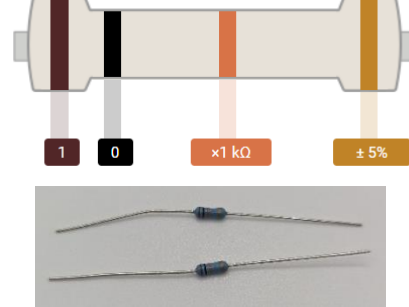
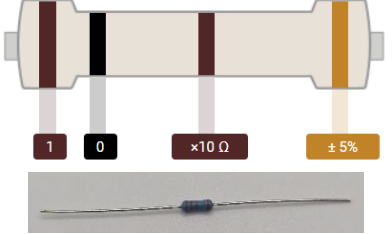

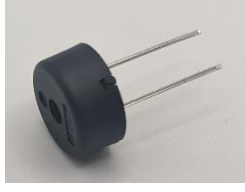
Assembly Guide

The assembly of the Forest Hub is comprised of three parts:

1. Part A: PCB Assembly
2. Part B: Firmware
3. Part C: Enclosure Assembly

Part A: PCB Assembly

Part A Components

1	Forest Hub PCB	QTY 1	2	Capacitor, 10uF	QTY 1	3	Resistor R1, 220Ω	QTY 1
								
4	Resistor R3, 2.2KΩ	QTY 1	5	Resistor R4, 4.7KΩ	QTY 1	6	Resistor R2/R6, 10KΩ	QTY 2
								
7	Resistor R5, 100Ω	QTY 1	8	Tactile Buttons	QTY 2	9	Piezo Buzzer PS1240	QTY 1
								

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10	TRRS Jack	QTY 1	11	Mono Switch Jacks	QTY 5	12	Modular Connector (RJ25)	QTY 1
								
13	Adafruit Qt PY SAMD21	QTY 1	14	Headers, Female, 7 Position	QTY 2	15	NeoPixel LEDs, 5 mm though hole	QTY 5
								
16	Forest LED Spacer	QTY 1	17	Forest Enclosure Top	QTY 1	18	Screw, #4, 3/8" Length	QTY 1
								
19	Forest Enclosure Bottom	QTY 1	20	USB-C Cable	QTY 1	21	Solderless Breadboard	QTY 1
								

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Part A Tools

- Soldering iron
- Flush cutters
- Phillips Head Screwdriver

Part A Personal Protective Equipment (PPE)

- Safety glasses

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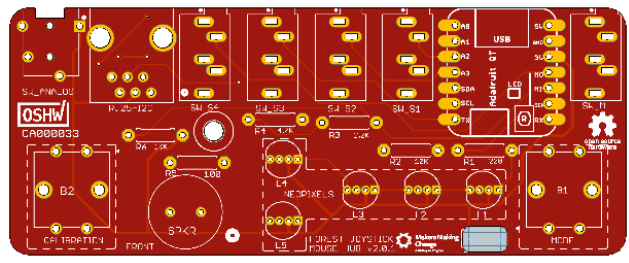
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Part A Steps

Step 1: Insert and Solder Capacitor

Take the capacitor and bend the metal leads on either side so they will line up with the holes labelled C1 on the PCB.

Insert the capacitor leads all the way into the C1 holes. Solder in place and trim the excess leads off.

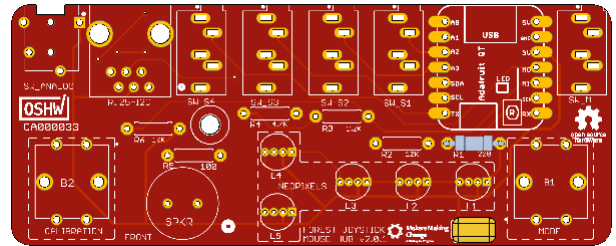
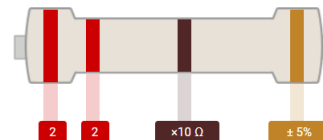


Step 2: Insert and Solder R1 Resistor

Take the R1 resistor (220 Ω) and bend the metal leads on either side so they will line up with the holes labelled R1 on the PCB.

Insert the resistor leads all the way into the R1 holes.

Flip the board to the back, solder in place and trim the excess leads off.

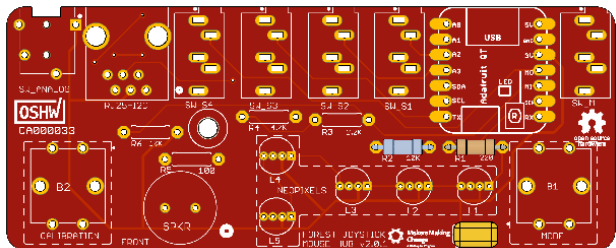
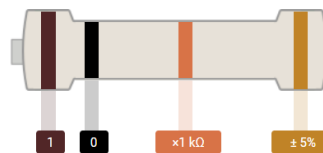


Step 3: Insert and Solder R2 Resistor

Take the R2 resistor (10K Ω) and bend the metal leads on either side so they will line up with the holes labelled R2 on the PCB.

Insert the resistor leads all the way into the R2 holes.

Flip the board to the back, solder in place and trim the excess leads off.

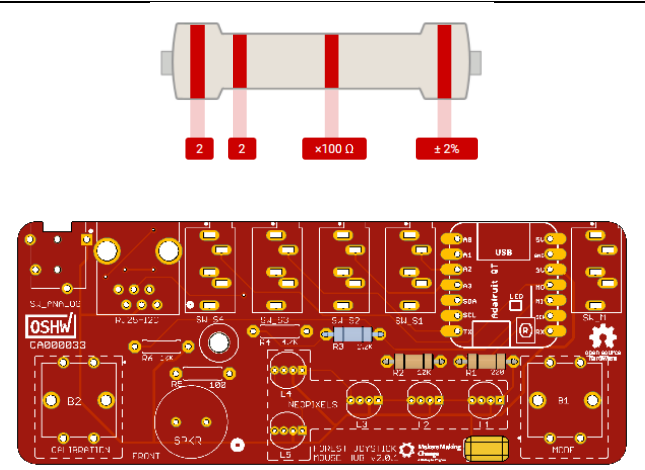


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Step 4: Insert and Solder R3 Resistor (Component 4)

Take the R3 resistor (2.2K Ω) and bend the metal leads on either side so they will line up with the holes labelled R3 on the PCB.

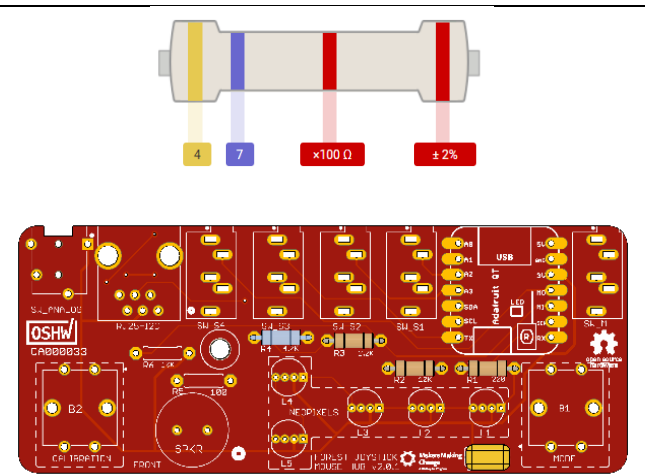
Insert the resistor leads all the way into the R3 holes. Solder in place and trim the excess leads off.



Step 5: Insert and Solder R4 Resistor (Component 5)

Take the R4 resistor (4.7K Ω) and bend the metal leads on either side so they will line up with the holes labelled R4 on the PCB.

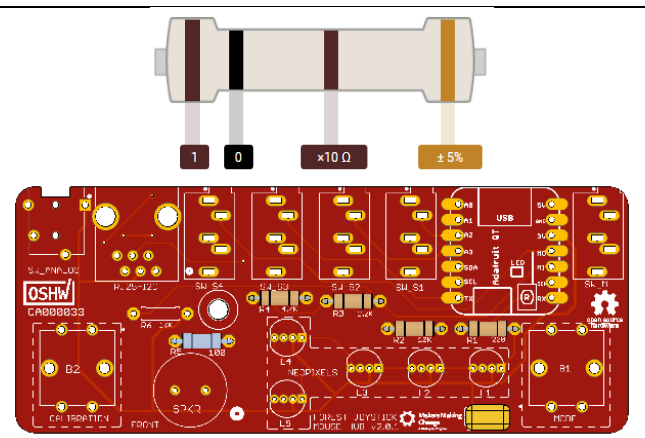
Insert the resistor leads all the way into the R4 holes. Solder in place and trim the excess leads off.



Step 6: Insert and Solder R5 Resistor (Component 7)

Take the R5 resistor (100 Ω) and bend the metal leads on either side so they will line up with the holes labelled R5 on the PCB.

Insert the resistor leads all the way into the R5 holes. Solder in place and trim the excess leads off.



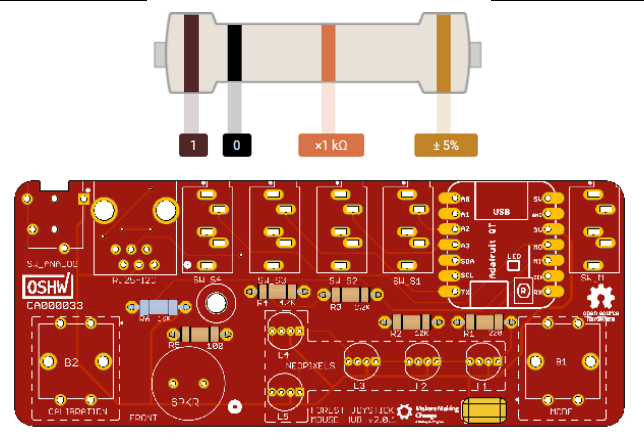
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Step 7: Insert and Solder R6 Resistor (Component 6)

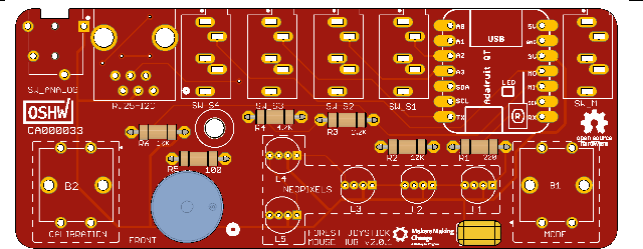
Take the R6 resistor (10K Ω) and bend the metal leads on either side so they will line up with the holes labelled R6 on the PCB.

Insert the resistor leads all the way into the R6 holes. Solder in place and trim the excess leads off.



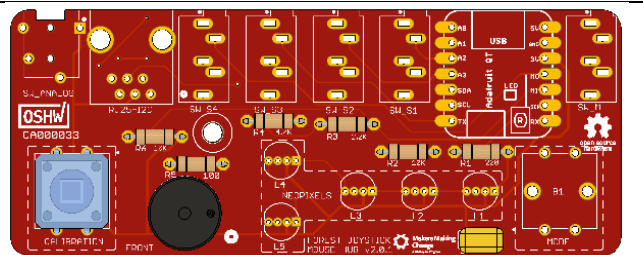
Step 8: Insert and Solder Buzzer

Take the Buzzer (Component 9) and insert the leads all the way into the PCB holes labelled with a speaker icon from the top. Solder in place and trim the excess leads.



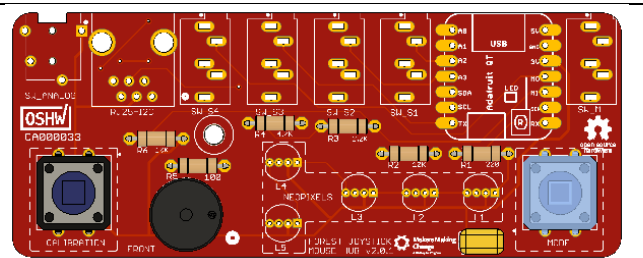
Step 9: Insert and Solder Calibration Button

Take a button (Component 8) and insert the leads all the way into the PCB holes labelled CALIBR from the top. Solder a single pin, check that the component is fully flush to the PCB, and solder the remaining pins.



Step 10: Insert and Solder Mode Button

Take a button (Component 8) and insert the leads all the way into the PCB holes labelled Mode from the top. Solder a single pin, check that the component is fully flush to the PCB, and solder the remaining pins.

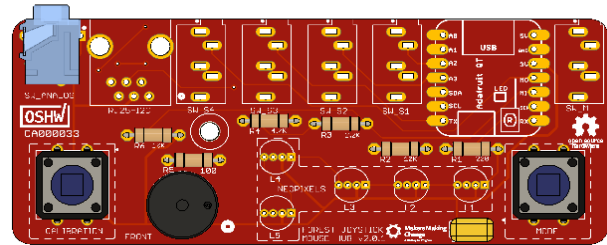


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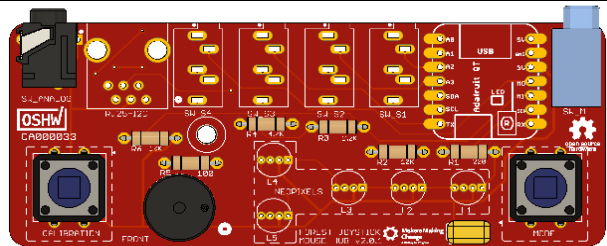
Step 11: Insert and Solder TRRS Jack

Take the TRRS jack (Component 10) and insert the leads all the way into the PCB holes labelled SW_ANALOG from the top. Solder a single pin, check that the component is fully flush to the PCB, and solder the remaining pins.



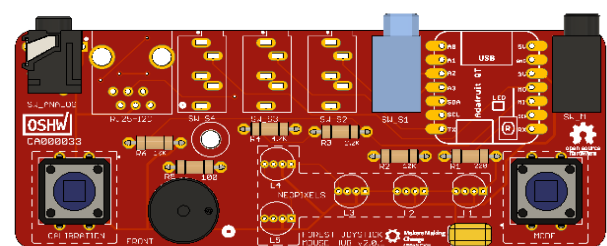
Step 12: Insert and Solder SM Audio Jack

Take an audio jack (Component 11) and insert the leads all the way into the PCB holes labelled SW_M from the top. Solder a single pin, check that the component is fully flush to the PCB, and solder the remaining pins.



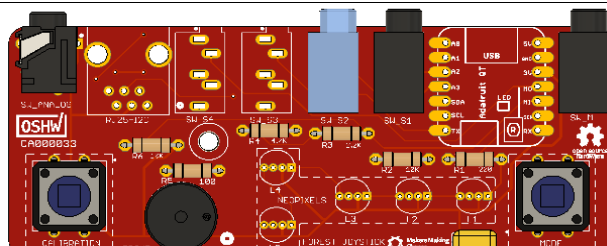
Step 13: Insert and Solder S1 Audio Jack

Take an audio jack (Component 11) and insert the leads all the way into the PCB holes labelled SW_S1 from the top. Solder a single pin, check that the component is fully flush to the PCB, and solder the remaining pins.



Step 14: Insert and Solder S2 Audio Jack

Take an audio jack (Component 11) and insert the leads all the way into the PCB holes labelled SW_S2 from the top. Solder a single pin, check that the component is fully flush to the PCB, and solder the remaining pins.

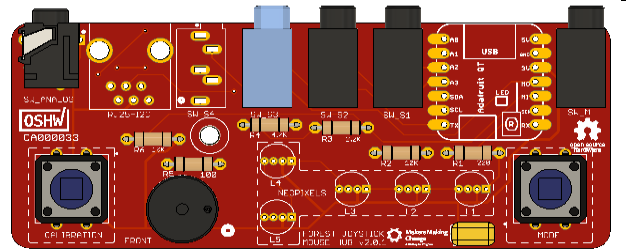


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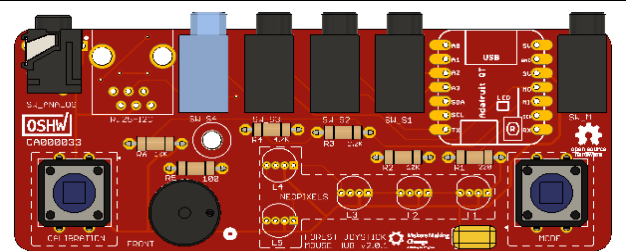
Step 15: Insert and Solder S3 Audio Jack

Take an audio jack (Component 11) and insert the leads all the way into the PCB holes labelled SW_S3 from the top. Solder a single pin, check that the component is fully flush to the PCB, and solder the remaining pins.



Step 16: Insert and Solder S4 Audio Jack

Take an audio jack (Component 11) and insert the leads all the way into the PCB holes labelled SW_S4 from the top. Solder a single pin, check that the component is fully flush to the PCB, and solder the remaining pins.

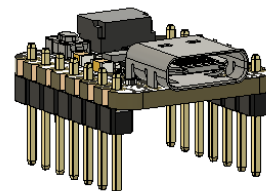
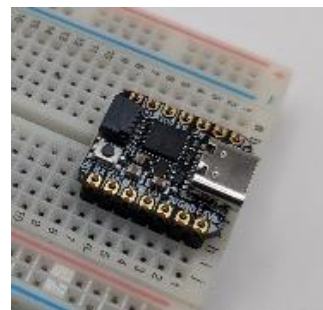
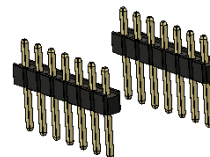
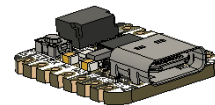


Step 17: Insert and Solder Male Headers to QT Py

Take the QT Py microcontroller and male headers (Component 13). If necessary, use the flush cutters to separate the male headers into two 7 position segments.

If you have a solderless breadboard:

- Insert the long leads of the male headers into the breadboard and insert the microcontroller on top. Solder the pins in place and remove the assembly.

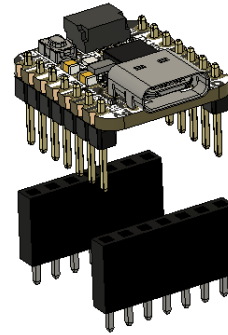


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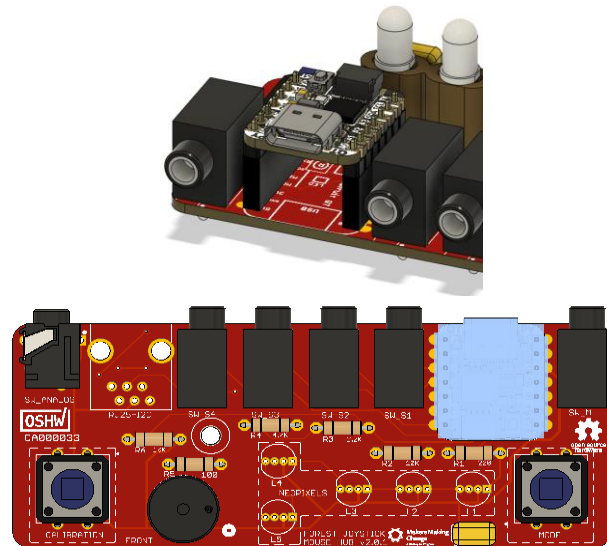
If you do not have a solderless breadboard:

- Insert the male headers into the microcontroller board.
- Use the female heads rotated 90 degrees to provide the correct spacing.
- Solder a single male header pin to the microcontroller, ensuring the headers are perpendicular to the PCB and the microcontroller is parallel with the PCB.
- Check that the male headers are flush and perpendicular to the microcontroller, solder the remaining male headers pins in place.



Step 18: Insert and Solder Female Headers

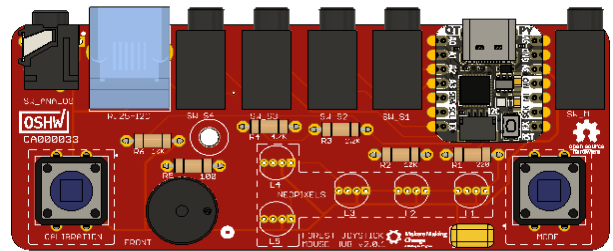
Insert the male headers into the female headers (Component 14) and insert the female headers into the PCB holes outlined with the microcontroller footprint from the top. Solder a single pin of one female header and check to ensure the female headers are flush and perpendicular with the PCB. Solder the remaining female header pins.



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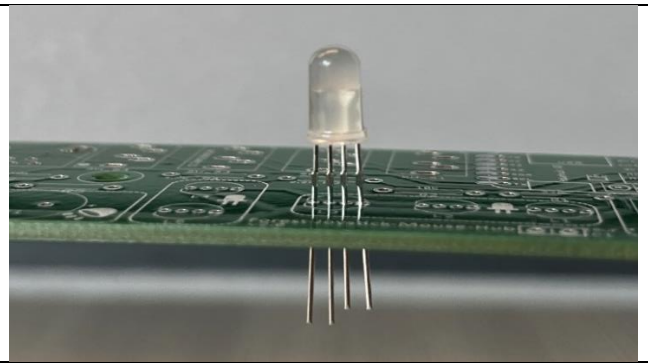
Step 19: Insert and Solder RJ25 Connector

Take the RJ25 Modular connector and insert it into the PCB holes located between SW_S4 and SW_ANALOG. Solder a single pin, check that the component is fully flush to the PCB, and solder the remaining pins.



Step 20: Space out NeoPixel LED Leads by Inserting into PCB

Insert each of the NeoPixel LEDs into the PCB to correctly space out the NeoPixel leads, **then remove the NeoPixels** from the PCB. This will make the next step less difficult. The longer leads should be oriented towards the left.



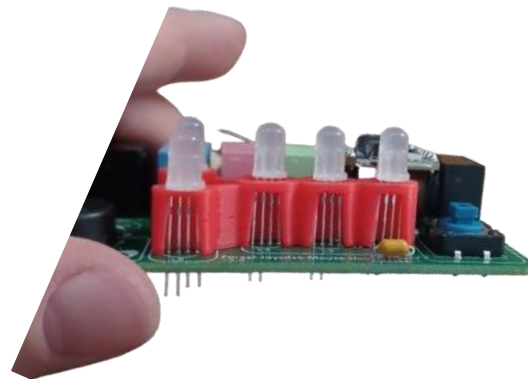
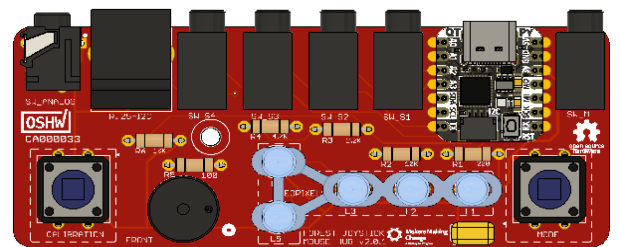
Step 21: Insert NeoPixel LEDs using Forest LED Spacer

Take the NeoPixel LEDs (Component 15) and the Forest LED spacer (Component 16). Line up and place the spacer over the PCB holes labelled L1, L2, L3, L4, and L5.

Ensuring that the flat side of the NeoPixel LEDs lines up with the outline on the PCB (all LED flat sides should face towards the Buzzer), insert the LEDs into the PCB. The longer leads should be oriented towards the left.

If needed, use a small tool such as a toothpick to guide the leads into the PCB.

Solder in place and trim the excess leads.



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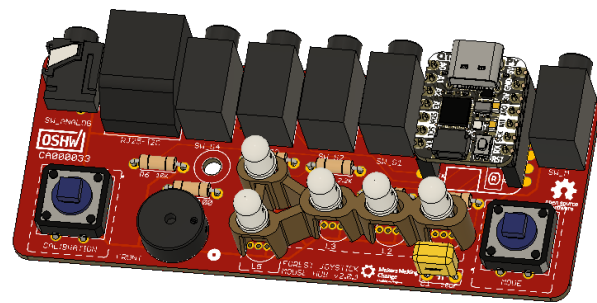
Step 22: Doublecheck LED soldering

Visibly check for solder bridges (solder going between and connecting the pads) on the pads for the NeoPixels LEDs. If there are any, remove the connecting solder.



Step 23: PCB is Fully Assembled

The Forest Hub PCB is now fully assembled. Move to Part B: Firmware.



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Part B: Firmware

Part B: Firmware Steps

Step B1: Setup Arduino IDE

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

Step B2: Setup Arduino IDE for QT Py 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://adafruit.github.io/arduino-board-index/package_adafruit_index.json
5. Click on **OK**.
6. Restart the Arduino IDE.
7. Open the **Boards Manager** option from the **Tools-> Board-> Boards Manager...**,
8. Search for “Adafruit SAMD” and select “Adafruit SAMD Boards” by Adafruit.
9. Click **Install** to install the board.

Step B3: Install Libraries

1. In a web browser, go to https://github.com/cyborg5/TinyUSB_Mouse_and_Keyboard and go to Code -> Download ZIP.
2. In Arduino IDE, click **Sketch -> Include Library -> Add .ZIP Library**.
3. Navigate to the ZIP file downloaded in Step (a). Click **OK**.
4. Go to **Tools -> Manage Libraries...**, search for “Flash Storage” and install the library “FlashStorage” by Various.
5. Go to **Tools -> Manage Libraries...**, search for “Adafruit_Neopixel” and install the library “Adafruit_Neopixel” by Adafruit.
6. Go to **Tools -> Manage Libraries...**, search for “WiiChuck” and install the library “WiiChuck” by Kevin Harrington.

Step B4: Setup Local Code Directory

1. Download the Firmware_Files from the GitHub Repository:
https://github.com/makersmakingchange/Forest-Hub/blob/main/Build_Files/Firmware_Files/Forest_Hub_Firmware.zip
2. Extract / unzip the folder to a known location.

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3. Confirm that you have the following folder structure:

- Forest_Hub_Firmware (folder)
 - o Forest_Hub_Firmware.ino
 - o OpenAT_Joystick_Response.h
 - o XACGamepad.h

Step B5: Upload the Code to the microcontroller

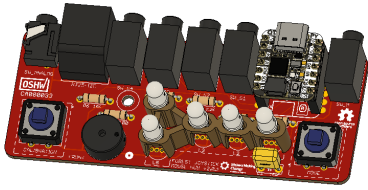




1. Open Forest_Hub_Firmware.ino with Arduino IDE.
2. Select **Adafruit QT Py M0 (SAMD21)** from **Tools -> Board -> Adafruit SAMD Boards**
3. Click on **Tools -> USB Stack** and select **TinyUSB**
4. Connect the Forest Hub using the USB cable to the computer.
5. Select the correct port from **Tools -> Port** menu.
6. Verify and upload the code.

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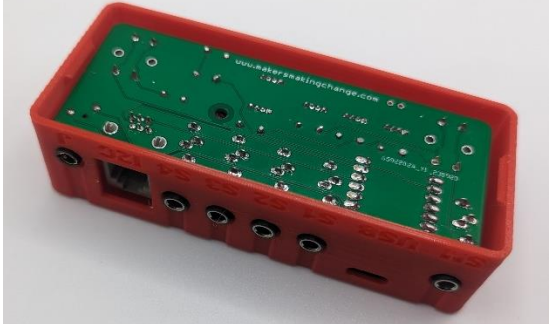
Part C: Enclosure Assembly

Part C Components

22	Assembled Forest Hub PCB	QTY 1	17	Forest Enclosure Top	QTY 1	18	Screw, #4, 3/8" Length	QTY 1
								
19	Forest Enclosure Bottom	QTY 1	20	USB-C Cable	QTY 1			
								

Part C Steps

Step C1: Insert PCB into Enclosure Top

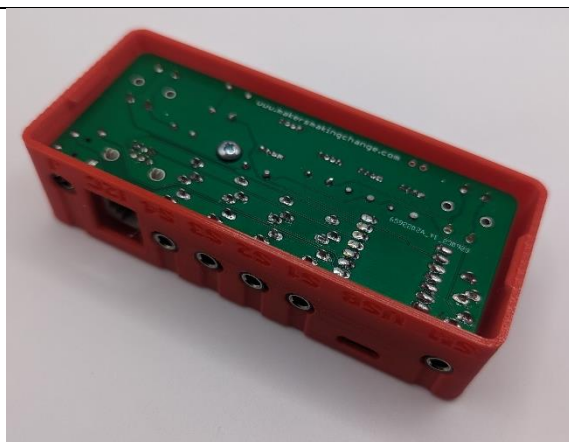
Insert the assembled PCB into the Enclosure Top.	
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Step C2: Secure PCB into place with Screw

Secure the PCB in place with using the #4 screw and the Phillips screwdriver.



Step C3: Snap Enclosure Bottom

Position the Enclosure Bottom over the Enclosure Top and push down to snap in place.



Step C4: Enclosure Finished

Flip the device over. The Forest Hub is now complete.



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Testing

To test the Forest Hub, you will need an analog joystick and at least one (1), but up to preferably five (5) assistive switches.

Testing using an Xbox Adaptive Controller

1. Connect the Forest Hub into the Left USB port for the left joystick or the Right USB port for the right joystick.
2. Connect the Xbox Adaptive Controller (XAC) using a USB-C cable to the computer.
3. If using Windows, open “Set up USB Game Controllers” from the Control Panel. You can find this by searching your computer in the search bar next to the Windows icon.
4. Select the Xbox Adaptive Controller from the list of controllers and go to “Properties”.
5. Move your joystick and observe the movement of the cross hatch in the “Axes” window. Ensure it moves in the proper directions when you move the joystick (the arrow points in the up direction). If not, open up the joystick and check your connections.

Testing using a PC

1. Connect the joystick using the USB C cable to the computer.
2. If using Windows, open “Set up USB Game Controllers” from the Control Panel. You can find this by searching your computer in the search bar next to the Windows icon.
3. Ensure that the joystick is registered as a game controller and select your joystick from the list and go to “Properties”.
4. Move your joystick and observe the movement of the cross hatch in the “Axes” window. Ensure it moves in the proper directions when you move the joystick (the arrow points in the up direction). If not, open the joystick and check your connections.
5. Using assistive switches plugged into each mono jack, activate each switch, and ensure that one of buttons 1-4 light up when you press the switch, and stops when you release the switch. If not, open the joystick and check your connections.

Troubleshooting

Nothing happens when I plug the device in.

- ➔ Double check to make sure there are no bridged connections. Double check the Neopixels and the RJ11 Connector.