



## Assembly Instructions



Sweep DIY 3D Scanner Kit

### A Note About Our Target Audience:

This kit is for those that enjoy DIY projects. It will require a good bit of tinkering to get the results you want. If you have questions, which you likely will, make it an opportunity to become a member of our forum (<http://community.scanse.io/c/3d-scanner>). We hope you have fun building it and learning how 3D scanners work.

### Software for This Project Can Be Found At:

<https://github.com/scanse/sweep-3d-scanner>

### 3D Models for This Project Can Be Found At:

<https://www.hackster.io/scanse/sweep-3d-scanner-035a5f>

### Documentation Revision Information

Rev	Date	Changes
0.93	5/16/2017	Initial Release
0.94	5/24/2017	Updated Sweep Install Photo
0.95	6/19/2017	Updated Sweep Scanner Bracket & Scanner Cover design
0.96	8/28/2017	Added troubleshooting guide

### Table of Contents

Introduction .....	2
Tools Required (not Included) .....	2
3D Printing the Enclosure Parts .....	2
3D Scanner Kit Contents .....	2
Test Fit All Parts .....	3
Step 1. Install Bearings in Cover .....	4
Step 2. Assemble Limit Switch .....	5
Step 3. Install Stepper Motor .....	6
Step 4. Assemble Motor HAT .....	7
Step 5. Assemble Female Micro USB Cable ...	8
Step 6. Install Bubble Spirit Level .....	9
Step 7. Install Raspberry Pi Assembly .....	11
Step 8. Install 90 Degree Scanner Bracket...	12
Step 9. Assemble Battery Holder .....	17
Step 10. Install 9 Axis IMU .....	20
Step 11. Install Battery onto the Scanner ....	22
Troubleshooting Guide .....	24



3D Scanner Exploded View

## Introduction

These assembly instructions will cover the mechanical assembly, programming and basic use of the Sweep 3D scanner add-on.

### Tools Required (not Included)

- Soldering Iron and Solder
- Wire Stripper
- Small Philips Head Screw Driver
- 2.5mm Hex Key with Ball End



### 3D Printing the Enclosure Parts

The three main enclosure parts and the cable clip are intended to be printable using a consumer desktop FDM (fused deposition modeling) style printer. You should get functional results when printing using a 0.2mm layer height. We have oriented the available STL files in the direction we have found they print best with the least amount of support material. We found that 20-30% infill works well. Our test parts were made using standard ABS filament, but PLA or other materials can work too (with PLA you need to worry about the parts melting in a hot car). You can also have these parts printed by a service like Sculpteo or Shapeways, but it will cost much more.

**Difficult to make parts:** The last 3D printed part – the custom Light Pipe, is intended to be printed using a clear resin with an SLA style printer. We realize this may not be as commonly accessible to most people, which is why we are offering a kit of parts for sale that includes all the 3D printed parts.

### 3D Scanner Kit Contents

We have assembled all the parts you need to make this project in one convenient kit. It includes about 60 parts, including the five necessary 3D printed parts. The 3D printed parts are made of black ABS, and are printed at 0.2mm layer heights. The one clear component is printed using SLA technology. The only thing not included in the kit is a Sweep sensor.

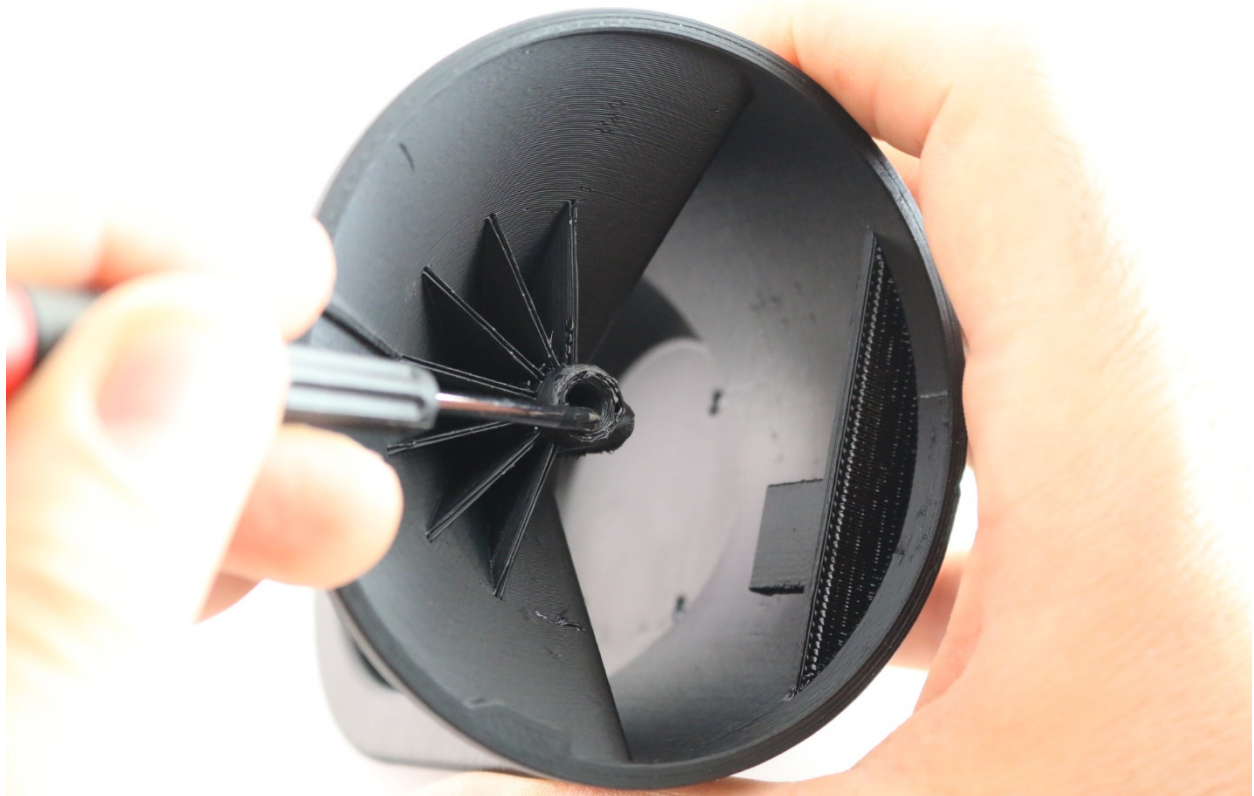
The kit is available for purchase on our website: <http://scanse.io/3d-scanning-kit/>



*Our 3D scanner kit includes everything you need to build this 3D scanner, except for tools listed above*

## Test Fit All Parts

When working with 3D prints, it is common for slight inaccuracies to be present. Use a small tool such as a screw driver to remove all support material and small defects.





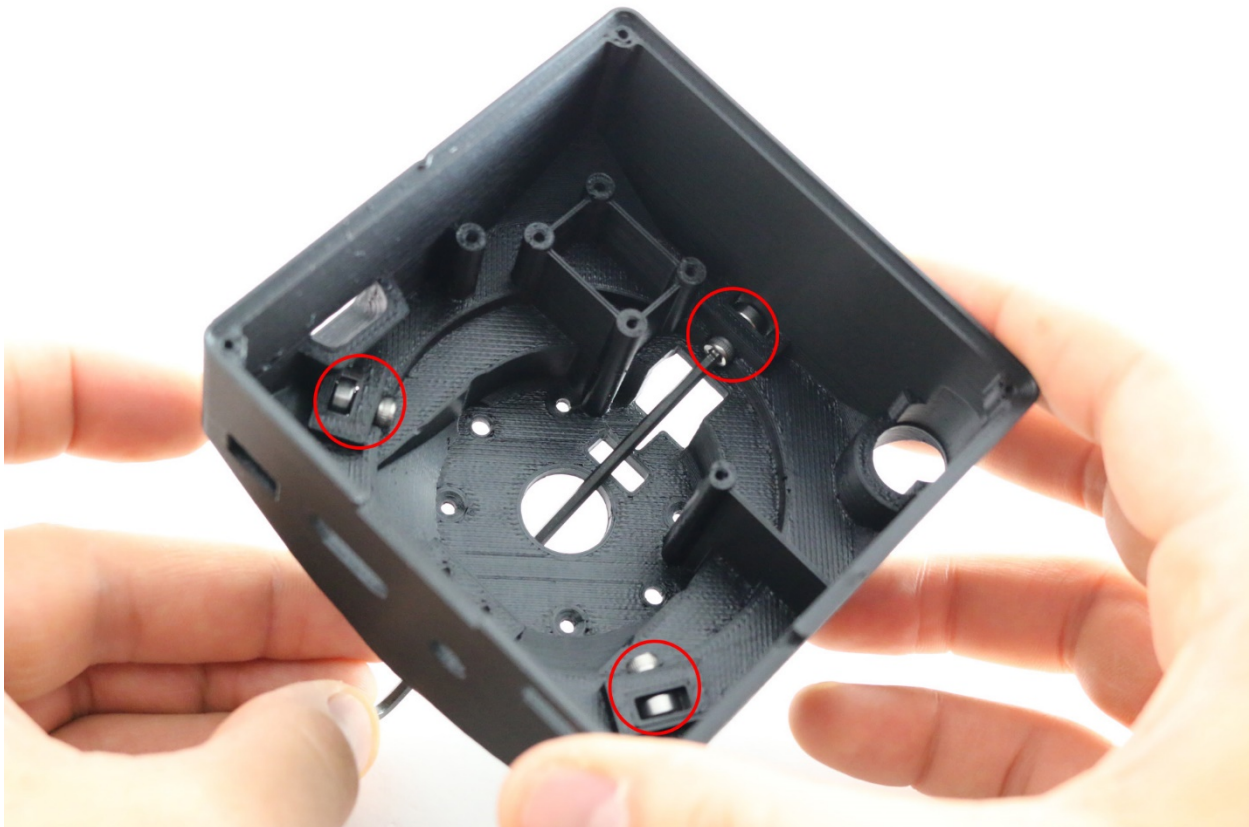
## Step 1. Install Bearings in Cover

Parts Needed:

- (3) 8MM OD, 3MM ID, 3MM Wide Bearings
- (3) M3 X 8MM Socket Head Cap Screws
- P0087 – Spherical Scanner Cover, Square 3D printed part



Make sure screw holes are clear of support material. Push bearings into the slots as shown and install the screws one at a time using the 2.5mm Hex Key as shown.



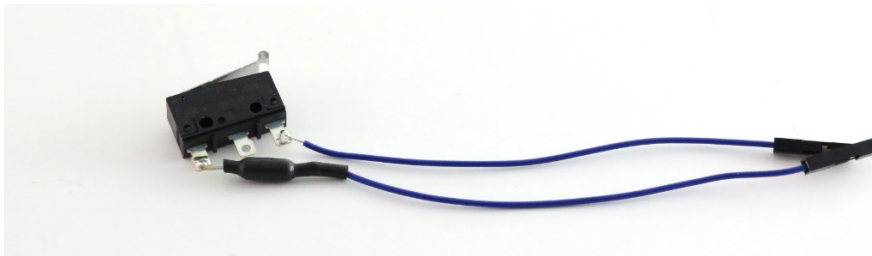
## Step 2. Assemble Limit Switch

Parts Needed:

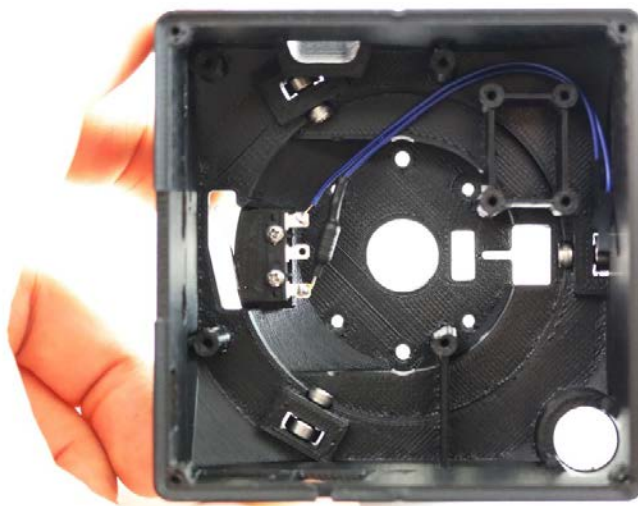
- OdiySurveil (TM) Simulated Roller Lever SPDT AC Miniature Micro Switch
- Female to female jumper wire cable
- 10K inline resistor
- Heat shrink tubing or electrical tape
- Phillips Drive, #2-28 Thread Size, 3/8" Length
- P0087 – Spherical Scanner Cover, Square 3D printed part.
- (2) Phillips Drive, #2-28 Thread Size, 3/8" Length



Solder one end of the 10K resistor onto the common pin of micro switch. Cut the jumper wire in half, so that each piece is approximately 100 mm (4 in) long. Strip the ends and solder one piece to the free end of the resistor. Solder the other piece to the NC (normally closed) tab of the micro switch. Cover the resistor with heat shrink tubing or electrical tape.



Install the micro switch into Spherical Scanner Cover in the orientation shown using the two screws. Make sure the switch operation is not hindered by 3D printed plastic.



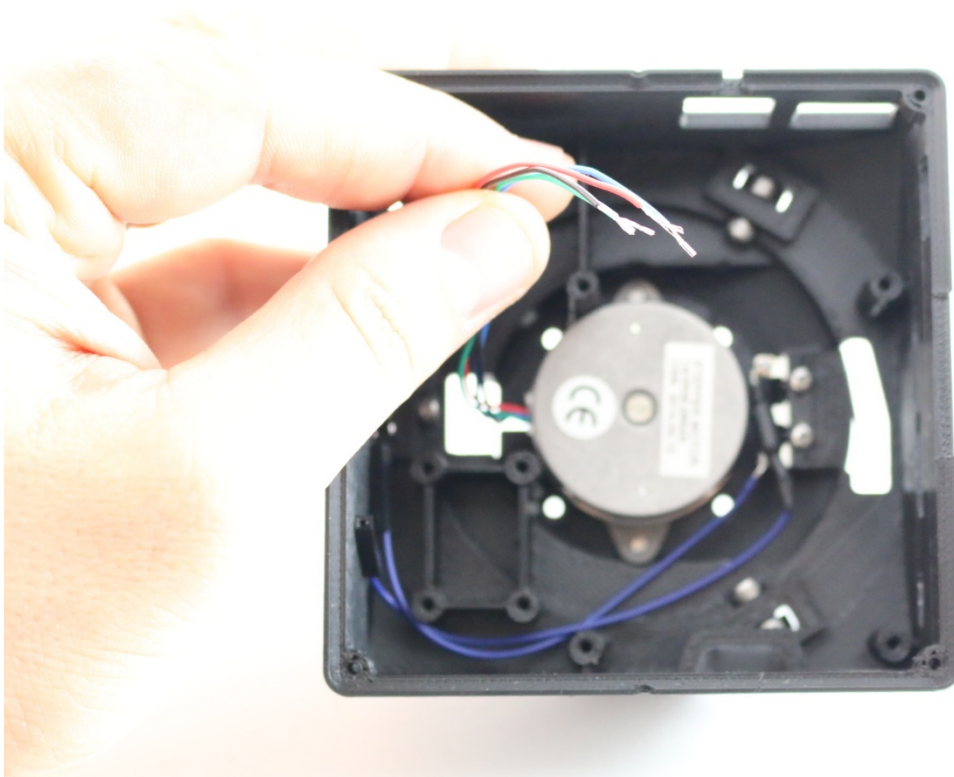
### Step 3. Install Stepper Motor

Parts Needed:

- 0.9deg Round Nema 14 Stepper Motor
- (2) M3x5mm Phillips Flat Countersunk Head Machine Screws
- P0087 – Spherical Scanner Cover, Square 3D printed part.



Cut motor wires to approximately 100mm (4 inches). Strip approximately 6mm (1/4 inch) off the ends. Screw motor into Scanner Cover in the orientation shown.

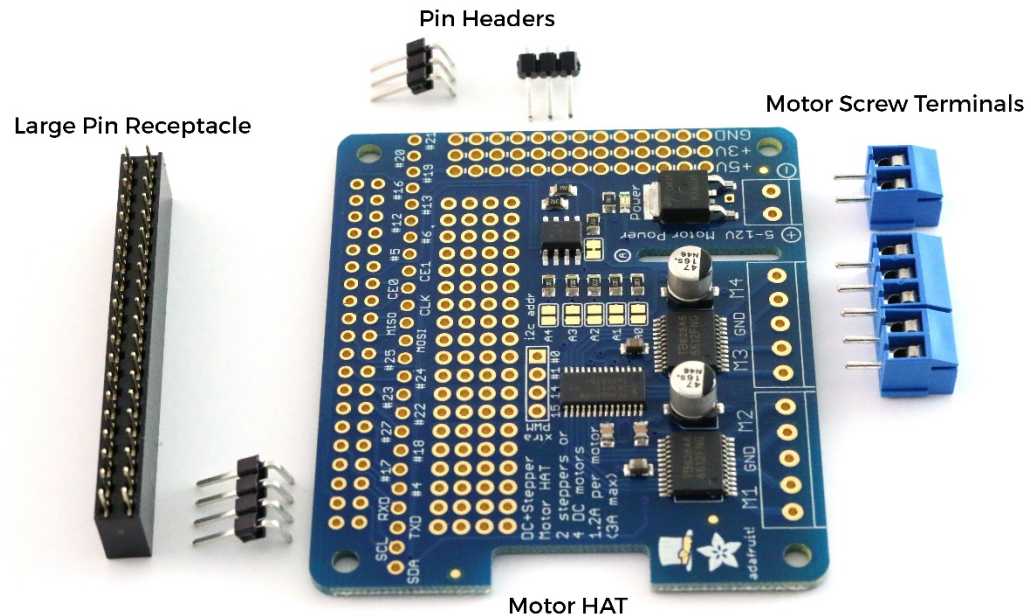




## Step 4. Assemble Motor HAT

Parts Needed:

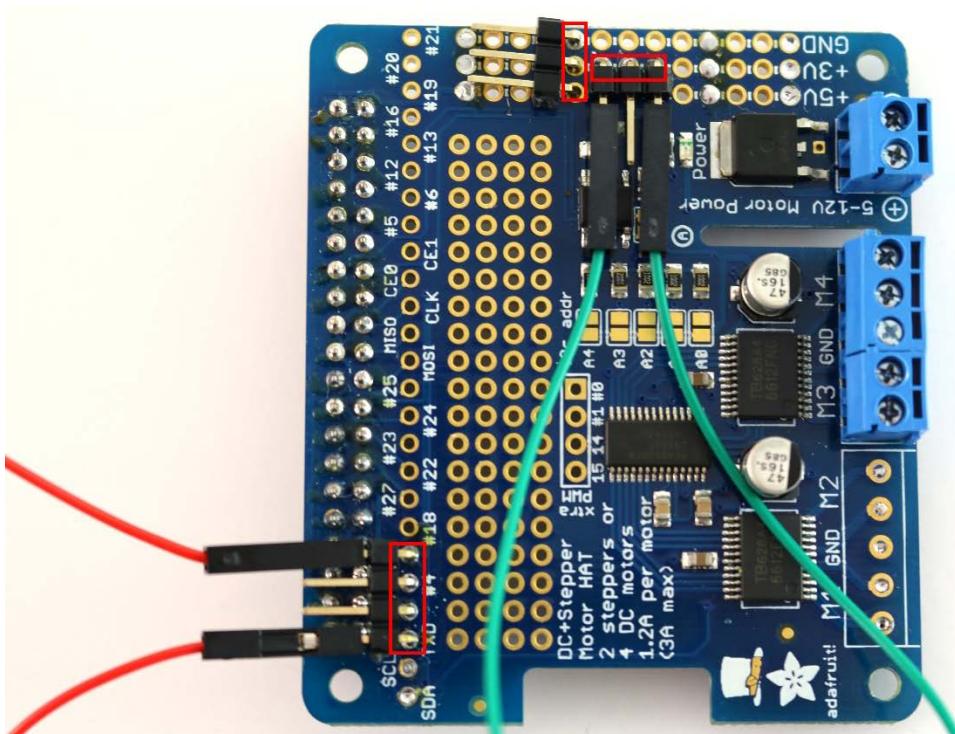
- Raspberry Pi 3 Model B
- Adafruit DC & Stepper Motor HAT for Raspberry Pi - Mini Kit
- 2.54mm Pitch Single Row Male 90 Degree Right Angle Pin Header
- Female to female jumper wire



Insert the motor screw terminals into motor HAT in the direction shown, then solder in place.

Next solder the large pin receptacle into the intended location.

Next, to maintain the correct spacing, slide the Female Jumper Wires onto the Pin Headers as shown, before soldering the headers in place. Once the headers are soldered in place, remove the jumper wire.

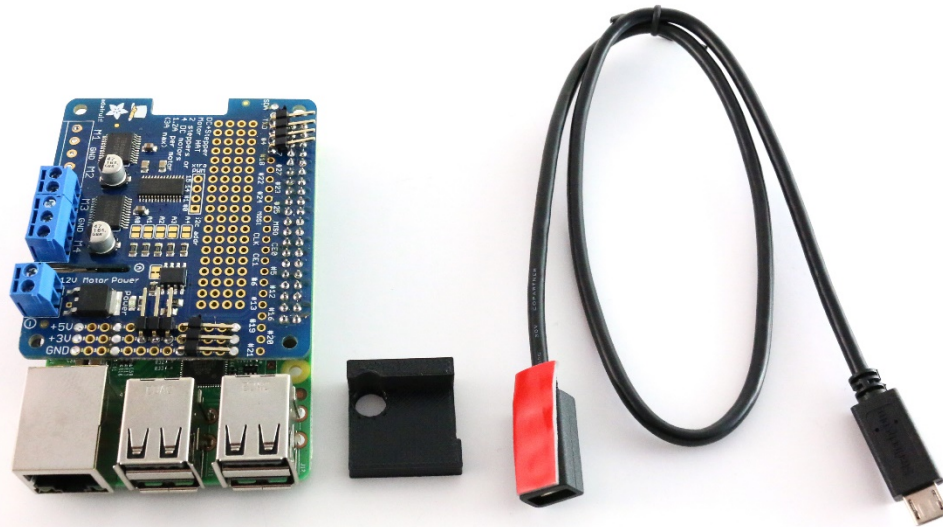


Finally, install the motor HAT onto the Raspberry Pi 3 Model B

## Step 5. Assemble Female Micro USB Cable

Parts Needed:

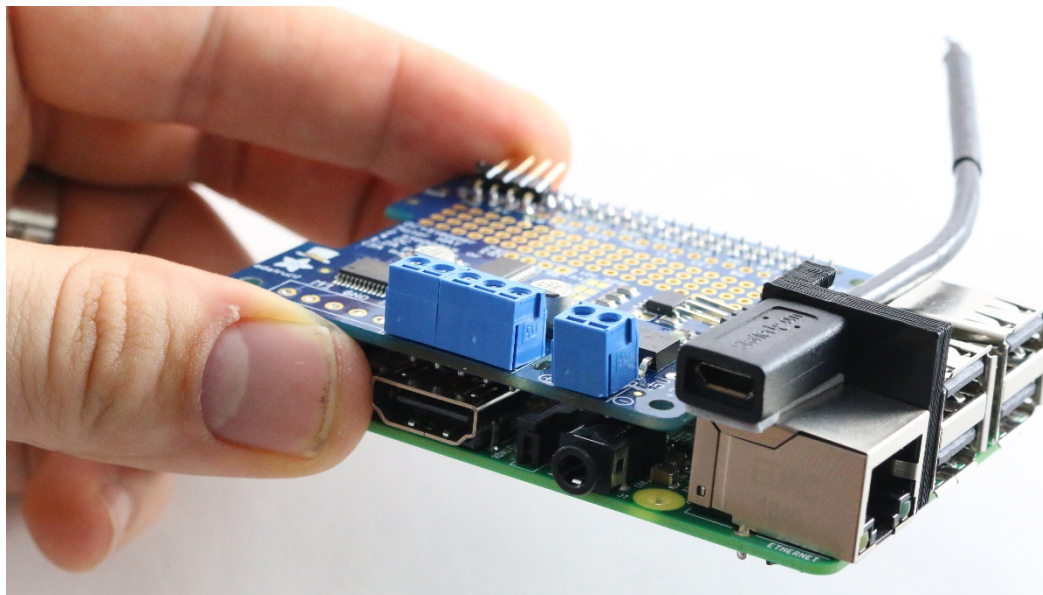
- StarTech.com 0.5m 20" Micro USB Male to Micro USB Female Cable (USBUBEXT50CM)
- Double sided tape (included on cable)
- P0090 – Spherical Scanner Cable Clip (3D printed part)
- 3.5mm (1/8 inch) Heat shrink tubing
- Motor HAT/Raspberry Pi Assembly



Cut the cable about 100mm (4 inch) from the female end. Strip off the outer rubber shield of the cable using a wire stripper blade. Separate the red (power) and black (ground) wires from the rest, and cut the other color wires back around 20mm (3/4 inch). Strip approximately 6mm (1/4 inch) of shielding off the ends of the black and red wires.

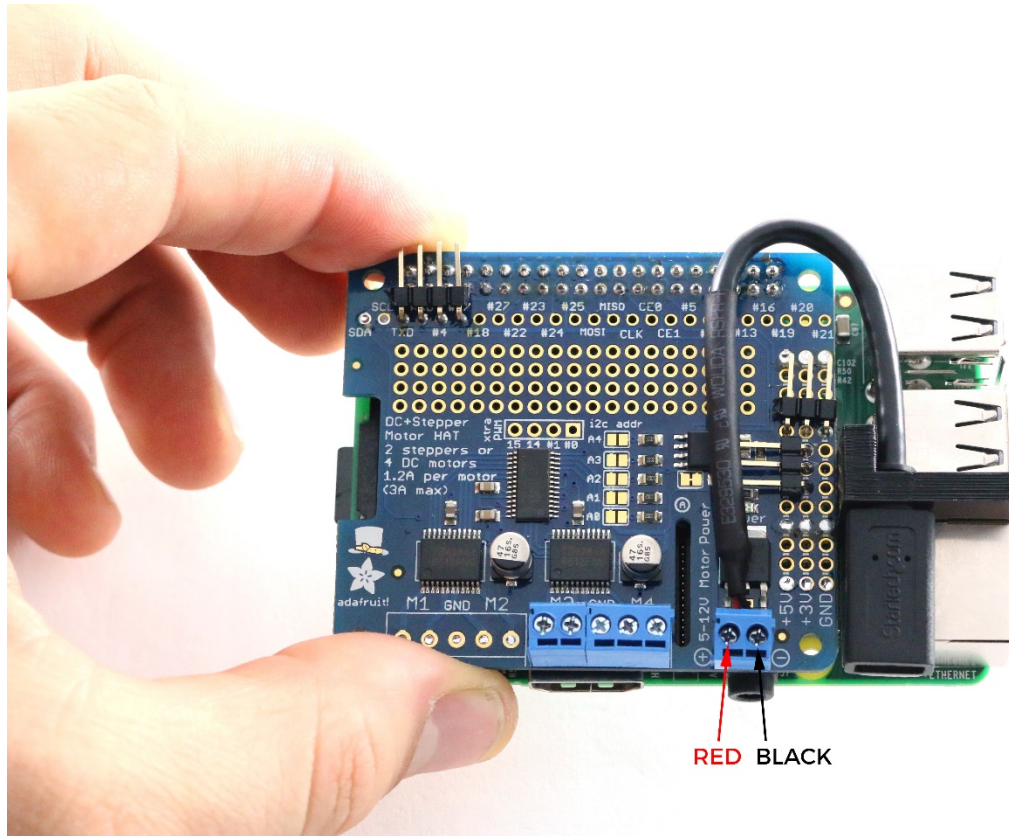
Remove the backing on the exposed side of the double-sided tape attached to the connector and slide the clip and cable into the Raspberry pi. Stick the connector to the top of the Ethernet port as shown.

Slide a 25mm (1inch) piece of 3.5mm (1/8 inch) diameter heat shrink tubing over the end of the cut wire, leaving the red and black wires poking out. Shrink in place, so that the exposed cable shielding is covered.





Insert the cable's red lead into the motor HAT screw terminal which read's "+ power", and the cable's black lead into the motor HAT screw terminal which reads "- power". Tighten the screw terminals as shown.



## Step 6. Install Bubble Spirit Level

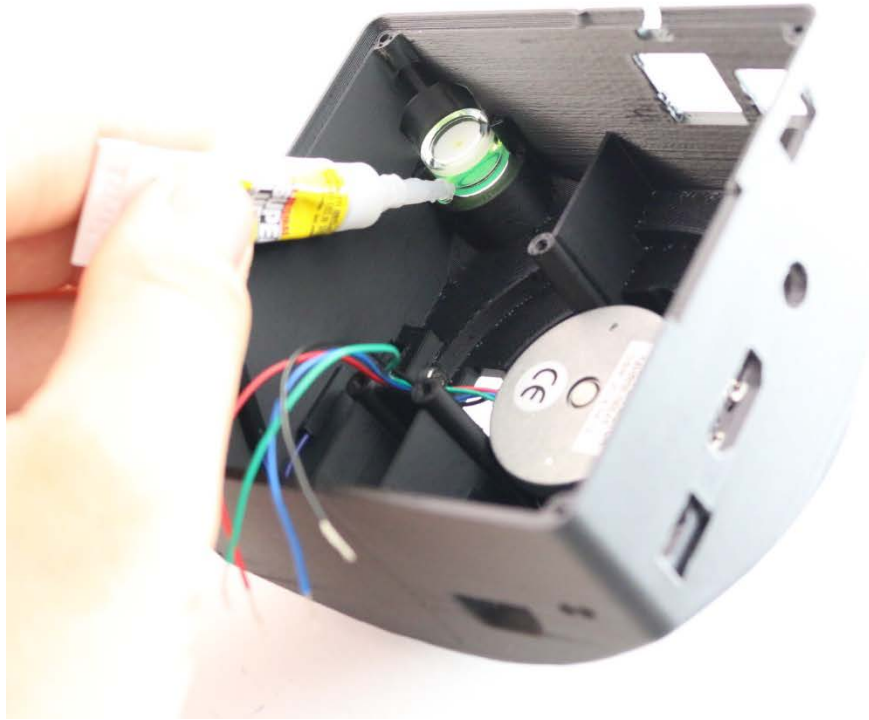
Parts Needed:

- 14mm Circular Bubble Spirit Level
- P0087 – Spherical Scanner Cover, Square 3D printed part.
- Super Glue



Start by finding a flat level surface (you can use the spirit level to check for this). Insert the spirit level into the scanner cover as shown. Then put the scanner cover on the flat level surface. Next use your fingers or a small tool like a screw driver to adjust the position of the spirit level in the hole until the bubble sits in the center when the scanner cover is sitting flat on the level table.

Put a few beads of glue around the spirit level and let it dry in a level position.



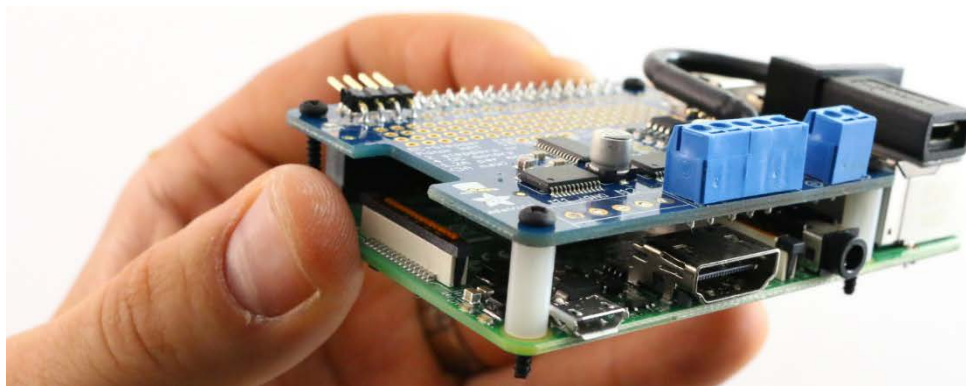
## Step 7. Install Raspberry Pi Assembly

Parts Needed:

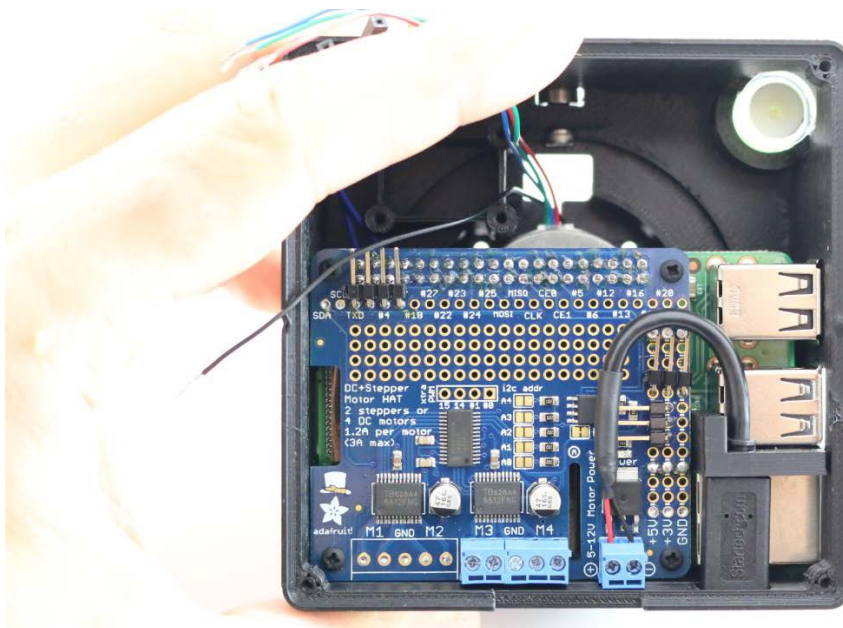
- (4) Steel Thread Rolling Screw for Plastic, Zinc Plated, Pan Head, Phillips Drive, #2-28 Thread Size, 3/4" Length
- (2) Nylon Unthreaded Spacers 3/16" OD, 7/16" Length, for Number 2 Screw Size
- P0087 – Spherical Scanner Cover, Square 3D printed part.



Insert the Nylon spacers between Raspberry Pi and Motor Hat mounting holes on the side next to the screw terminals, while inserting the screws through them as shown.



**IMPORTANT: WHEN INSTALLING THE RASPBERRY PI ASSEMBLY INTO THE COVER, YOU NEED TO REMOVE THE SD CARD. YOU CAN THEN SLIDE THE SD CARD BACK INTO THE PI FROM THE OUTSIDE.**





## Step 8. Install 90 Degree Scanner Bracket

### Parts Needed:

- Sweep Sensor
- Sweep Cable
- Sweep USB to Serial Adapter
- Sweep USB cable
- (4) M2.5x4mm 316 Stainless Steel Flat Head Phillips Machine Screws
- (1) Steel Thread Rolling Screw for Plastic, Zinc Plated, Pan Head, Phillips Drive, #2-28 Thread Size, 3/8" Length
- Small zip tie
- P0092 - 90 DEGREE CYLINDRICAL SCANNER BRACKET, TALL



Install the larger screw (which acts as a set screw) into the shaft hole as shown and thread part way in.



Assemble the Sweep Cable, Sweep USB to Serial Adapter and Sweep USB cable. Insert the cable through the scanner bracket and insert the cable into the sideways facing connector in the Sweep sensor.



Insert the Sweep sensor into the bracket as shown. **Line up the holes with the sweep connector facing downward and the sweep led facing upward**, and install the 4 small screws.



Mark a line with a pencil on the micro USB cable 3.25 inches (82.5mm) from the end of the micro USB connector. Feed the micro USB cable connector through the Scanner Cover hole shown, then connect the USB to Serial Adapter board.



Loop the serial cable inside the Scanner Bracket and then slide the USB to Serial Adapter board into the little clip inside the Scanner Bracket in the orientation shown. Make sure the serial cable is not touching the rotating head of the Sweep Scanner.





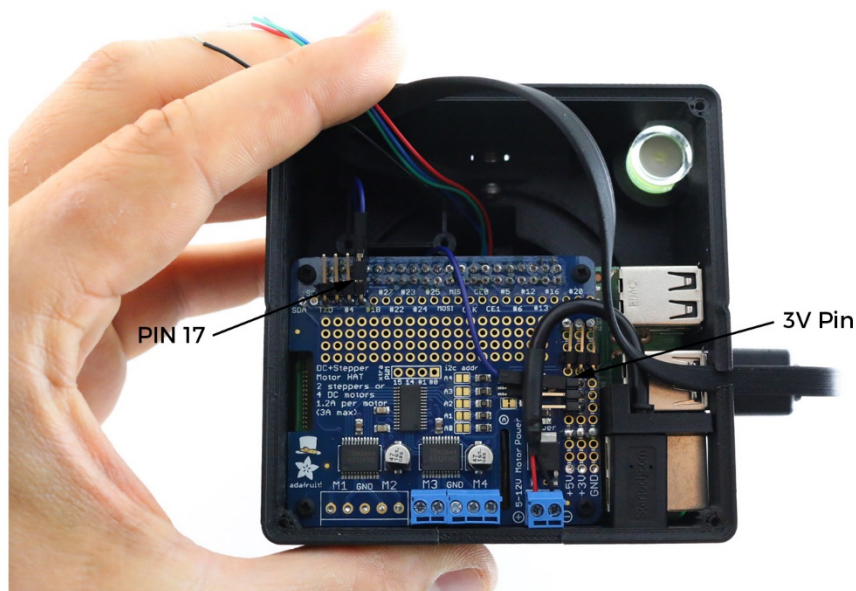
Pull the micro USB cable into the scanner cover, then slide it into the provided pinch slot where you the made the pencil mark earlier. Put as little twist in the cable as possible as shown.



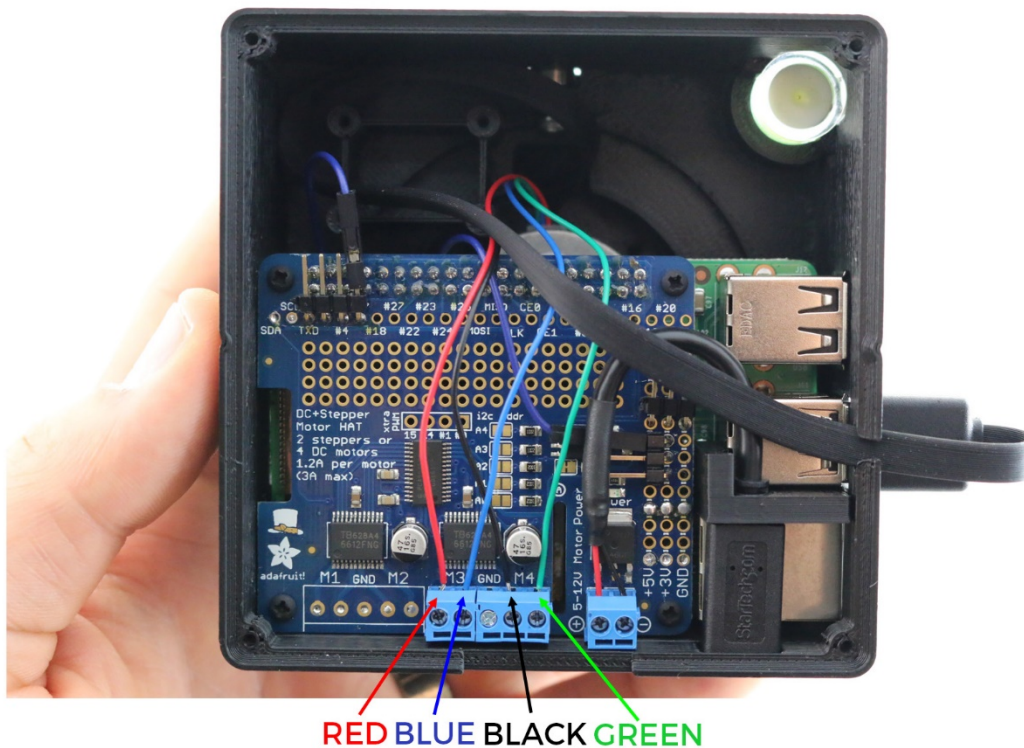
Make sure the flat on the stepper motor shaft is facing the set screw direction and push the 90-degree bracket onto the motor. Make sure it can freely rotate around 180 degrees, and correctly engages the limit switch. If you feel binding, gently pull the scanner bracket off the motor and remove any obstructions.

Run the Sweep USB cable out through the small slot on the side of the scanner cover and into the USB port on the Raspberry Pi.

Connect the limit switch wires to the Raspberry Pie. One lead should go to **pin 17** on the motor HAT header, while the other lead should go to one of the **3V pins** on motor HAT power rail.



Next connect the four stepper motors in the color sequence shown. Use a small screw driver to tighten the screw terminal. **Do a light pull test with your fingers to make sure the wires are being held in place snugly.**



The assembly should look like this:



## Step 9. Assemble Battery Holder

Parts Needed:

- SINOELE Ultra Slim Universal 10000mAh Power Bank for iOS and Android Smartphones – Black
- ¼-20 Nut
- P0091 - Spherical Scanner Light Pipe
- P0088 - Spherical Scanner Battery Holder, Square



Place the nut on the top of the hexagon hole, then put the tip of your soldering iron through the nut and turn it on (if you can control the temperature – set it to around 720F (382C)). Slowly guide the nut into the hole as the plastic melts around it.







Once the nut cools, insert the battery into the holder as shown with the power light facing upward. We have found that pushing the battery into the holder while keeping it parallel with the holder bottom works best.



You should be able to easily activate the battery's power button using the built in button on the 3D print.



Peel away the double sided tape backing and insert the light pipe into the slot in the battery holder as shown.

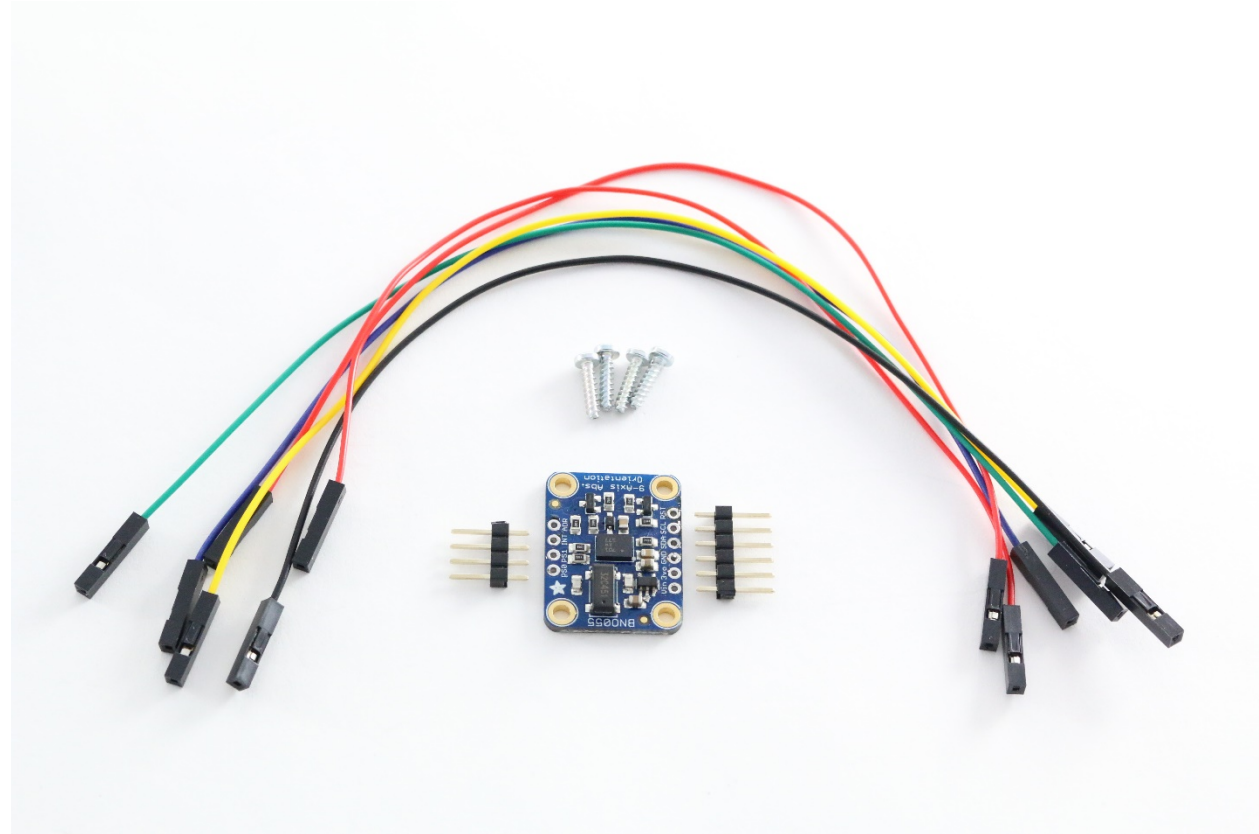


When you activate the battery's power button, you should see light exit the light pipe toward the outside of the device.

## Step 10. Install 9 Axis IMU

Parts Needed:

- Adafruit 9-DOF Absolute Orientation IMU Fusion Breakout - BNO055
- Female to female jumper wire Dupont cable (1) Blue, (1) Yellow, (1) Green, (1)Black, (2) Red
- (4) Steel Thread Rolling Screw for Plastic, Zinc Plated, Pan Head, Phillips Drive, #2-28 Thread Size, 3/8" Length



Solder pin strips into IMU circuit board with pins projecting out of the side with all the components on it.

Use the four screws to mount the IMU in the scanner cover, making sure to orient it with the 4 pins closer to the Raspberry Pi.

Follow this wire connection guide to connect the IMU to the Raspberry PI:

IMU->Wire Color->Motor HAT Connections

VIN ->Red Wire->+3V Rail

GND->Black Wire->GND Rail

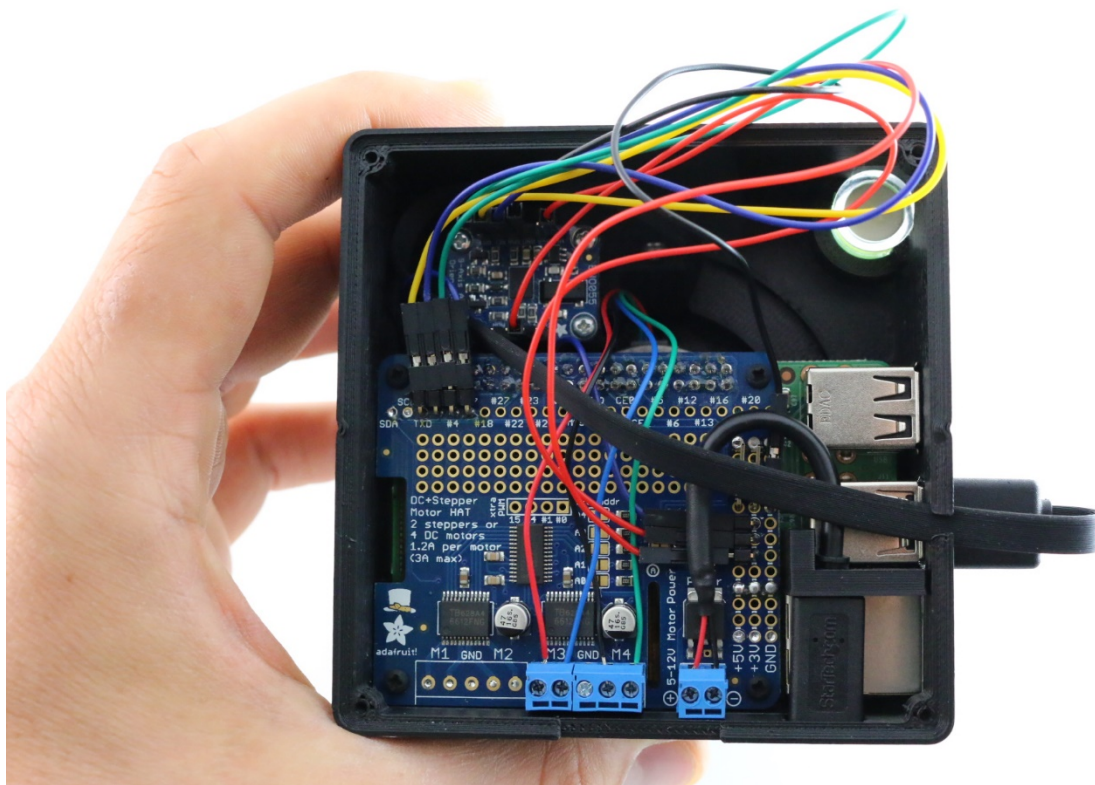
SDA->Blue Wire->RX0

SCL->Yellow Wire->TX0

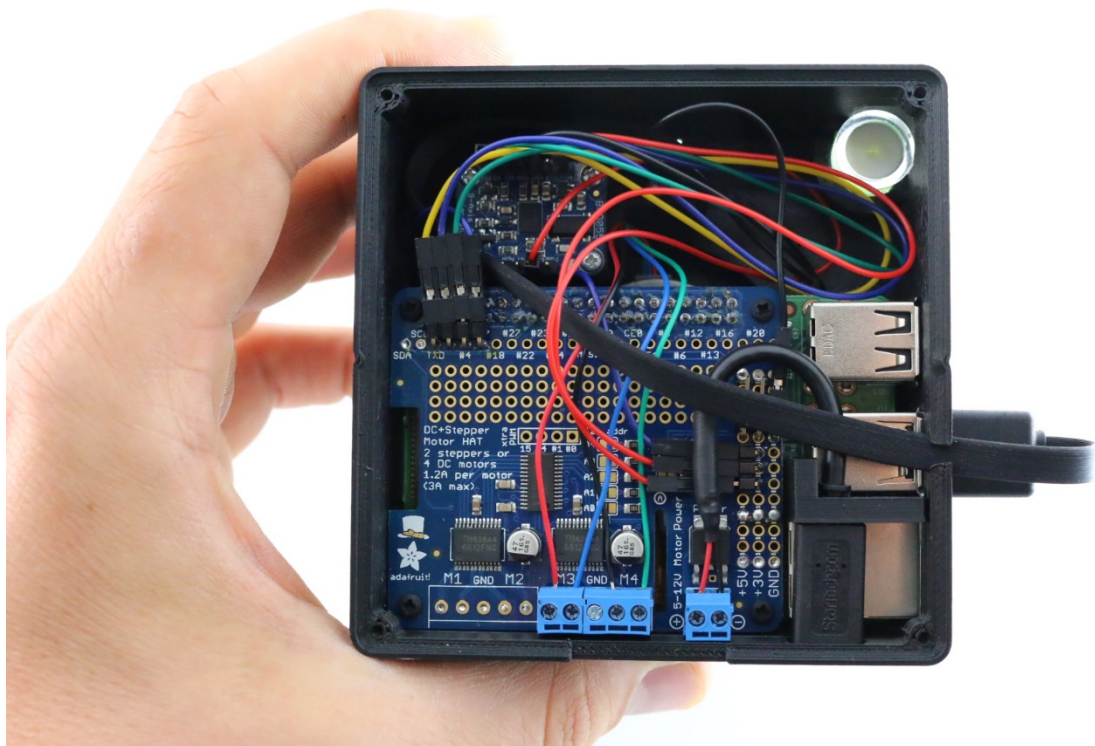
RST->Green Wire->#4

PS1->Red Wire->+3V Rail





Fold the wires into cover so they do not interfere with it attaching this assembly to the battery holder.



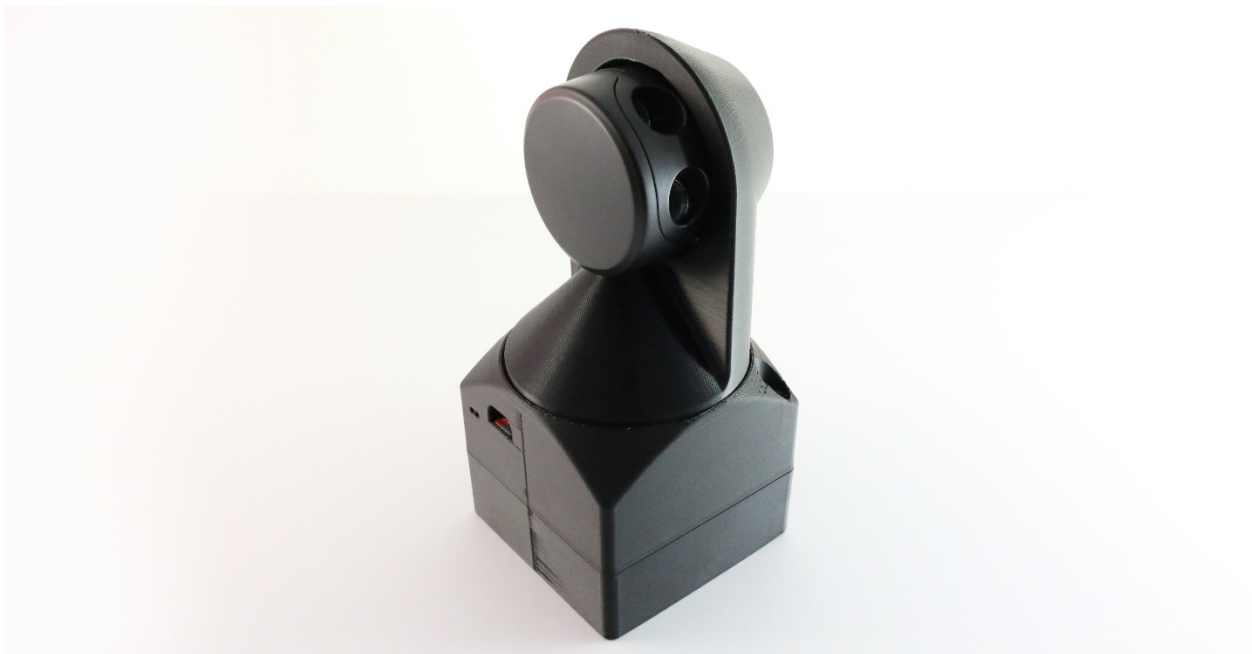
## Step 11. Install Battery onto the Scanner

Parts Needed:

- (4) Steel Thread Rolling Screw for Plastic, Zinc Plated, Pan Head, Phillips Drive, #2-28 Thread Size, 3/8" Length
- (2) Micro USB Short Cable



Use the four thread forming screws to mount the battery holder onto the scanner cover. **Be careful not to over-torque the screws, as they can strip out easily.**



If you haven't done so already, install the SD card with the 3D scanner control software image loaded. **For more information on installing the control software on the SD card, see the instructions included in our GitHub repository.** Connect the Battery to Raspberry Pi and motor control power ports using the short micro USB cables. The Raspberry Pi may turn on immediately. If not, press the power button on the battery.



This completes the mechanical assembly of you Sweep 3D scanner!

To learn more about the software, please see our 3D Scanner Getting Started Guide in our GitHub repository: <https://github.com/scanse/sweep-3d-scanner>



## Troubleshooting Guide

This troubleshooting guide is oriented toward mechanical issues. To find more information on software issues, please consult our software wiki here: <https://github.com/scanse/sweep-3d-scanner/wiki>.

Symptom	Possible Causes	Possible Solutions
No base movement	Motor HAT is not plugged into a power source.	Be sure the Motor HAT is plugged into the battery and that the battery is adequately charged.
Erratic base movement	Stepper motor wires are inserted in an incorrect order.  One or more wires are disconnected from the motor controller.	Double check the motor wiring in Step 8.
Friction when rotating the scanner bracket	Inaccuracies in the 3D print, or leftover support material are causing contact where there should be none.	Remove the scanner bracket and look for inaccuracies in the 3D prints. Carefully remove them with a small blade.
Friction or noise when the Sweep sensor spins inside the scanner bracket	The sweep sensor could be rubbing against the plastic of the scanner bracket.	Check for contact. If necessary, remove the Sweep sensor to check for interfering material and use a blade to remove the material.
Scanner does not make a full 180 degree rotation when a full scan is initiated	The scanner bracket is slipping on the stepper motor shaft.	Tighten the set screw in the scanner bracket. If it is stripped out, use glue to hold the set screw in place.
Sweep sensor stutters or freezes during part of the scan	The USB cable connecting the Sweep sensor to the base may be coiled incorrectly and rubbing against the Sweep scanner head.	Make sure the USB cable is coiled in the scanner bracket as shown in Step 8 of these assembly instructions. Make sure to pull any excess service loop into the scanner base.
Scans are coming out with a "corkscrew" skew to them	The scanner bracket may not be mounted perfectly co-axially relative to the stepper motor shaft.	Make sure the scanner bracket is pushed down as far as it will go onto the motor shaft, such that it rests on the three bearings mounted in the scanner cover during the entire 180-degree scanner rotation range.
Cannot see the Pi3-AP WiFi access point in available networks	The Raspberry Pi is not powered on or is still booting up. Image was not flashed correctly. SD card is corrupted.	Plug the Raspberry Pi into an adequate power source. Give the Pi time to boot up. Refresh list of visible networks. Make sure the SD card was flashed using a decompressed (unzipped) image file, and not the compressed .zip file. Plug the Pi into a power source. If that fails, double check the functionality of the Pi and SD card by flashing the latest Raspbian release direct from the RaspberryPi Foundation.
Cannot SSH into the Raspberry Pi	The host computer is not connected to the Pi3-AP WiFi access point. The credentials are incorrect.	Connect to the Pi3AP WiFi access point using password "raspberry". SSH into the Pi using the IP address "172.24.1.1" (or the hostname "sweep-3d-scanner") and password "raspberry".