

# Adaptive Focus GearVR Setup Guide

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## 1 Parts

Below is the entire parts list for building an Adaptive Focus GearVR. In each section, a smaller list will be provided of parts needed for that step. For links to where to purchase each part, visit: <https://docs.google.com/spreadsheets/d/1MU40nmQaf18gAx95LDQctQis0RnBB0yVALQBxRBF7tQ/edit?usp=sharing>. Also note that this guide does not include instructions for the calibration setup.

- Raspberry Pi 3
- MicroSD Card preloaded with NOOBS or MicroSD card + MicroSD card reader
- Two heat sinks with thermal adhesive strips for Raspberry Pi
- Keyboard and mouse
- Monitor with HDMI connector
- 2.5A power supply for Raspberry Pi
- Nema 17 bipolar stepper motor
- 1067 PhidgetsStepper bipolar HC board
- 5A, 12V AC/DC adaptor for Phidgets board
- 1 DC female barrel jack
- USB A to mini B cable
- 4 conductor multi-conductor cable 24 AWG
- 4-pin JST plug + receptacle cable
- 1 DC female barrel jack
- Heat shrink + heat shrink gun

- Waterproof enclosure
- Eye Tracking GearVR
- Nema 17 stepper motor mount
- 2' 1/8" I.D., 2' 1/4" O.D., 1/16" width o-ring
- 5mm bore set screw hub
- 2" I.D., 5mm bore v-belt pulley
- 4 6-32 x 1/4" machine screws + nuts
- Miniature screwdriver set
- Wire strippers
- Double-sided tape
- Super glue

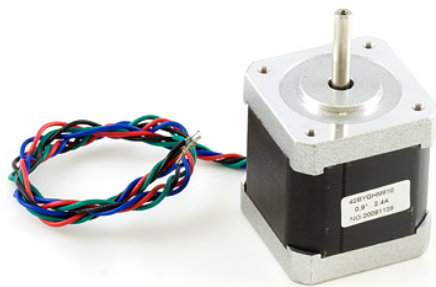
## 2 Setup Motor Extension Cable

### 2.1 Parts

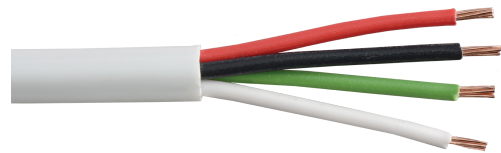
- Nema 17 bipolar stepper motor
- 4 conductor multi-conductor cable 24 AWG
- 4-pin JST plug + receptacle cable
- Heat shrink + heat shrink gun
- Wire strippers

### 2.2 Installation

Using a wire stripper, strip about 1/2" of wire from each side of the conductor cable. Connect one of the stripped ends of the conductor cable to the receptacle cable of the JST Plug using heat shrink. Then, connect the other end of the JST Plug to the end of the stepper motor cable using heat shrink. Make sure to note down the color mapping from motor wires to extension color wires. This will be needed in the next step.



(a) Nema 17 Bipolar Stepper Motor



(b) 4 Conductor Multi-Conductor Cable 24 AWG



(c) 4-pin JST Plug + Receptacle Cable

Figure 1: Motor Extension Components

## 3 Setup Motor Controller

### 3.1 Parts

- 1067 PhidgetsStepper bipolar HC board
- Nema 17 bipolar stepper motor
- DC female barrel jack
- 5A, 12V AC/DC adapter
- Miniature screwdriver set

### 3.2 Installation

Connect the bare wires of the extension cable into the 4 motor connectors on the PhidgetsStepper board. Make sure that the colors of the wires are connected in the order shown in figure 2.c. Note that due to the color difference between extension cable and motor cables, you will have to map the extension cable colors to the motor cable colors first.

Now, connect the bare wires of the barrel jack to the 2 power connectors on the board (black=negative).

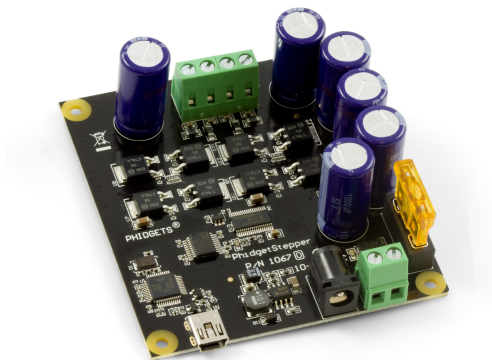
Finally, connect the AC/DC Adapter to the barrel jack and plug it in.

Additional information about the 1067 board can be found at: [http://www.phidgets.com/docs/1067\\_User\\_Guide](http://www.phidgets.com/docs/1067_User_Guide)

## 4 Setup Raspberry PI

### 4.1 Parts

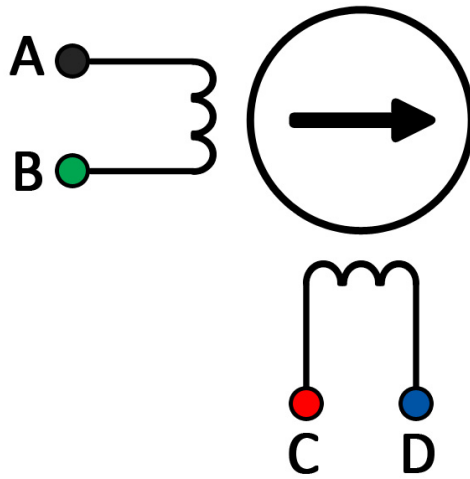
- Raspberry Pi 3
- 2.5A power supply for Raspberry Pi
- Keyboard and mouse
- Monitor with HDMI connector
- MicroSD card preloaded with NOOBS or MicroSD card + MicroSD card reader
- Two heat sinks with thermal adhesive strips
- USB A to mini B cable



(a) 1067 PhidgetStepper Bipolar HC Board

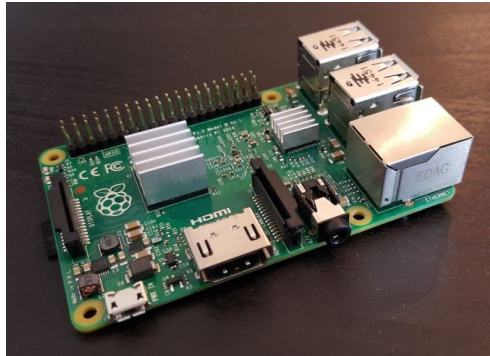


(b) DC Female Barrel Jack



(c) Motor Wires to Board Connector Mapping (for clockwise rotation)

Figure 2: Motor Controller Components



(a) Raspberry Pi 3 with Heat Sinks

Figure 3: Raspberry PI Components

## 4.2 Install Heat Sinks

First, remove the covering from the bottom of the thermal adhesive strips on the heat sinks and install them onto the Raspberry Pi as shown in figure 3.a.

## 4.3 Install Software

The Raspberry Pi software has the following dependencies:

- NodeJS
- Python
- Phidgets Libraries for Linux
- Phidgets Python SDK

If you are using a blank MicroSD card, visit <https://www.raspberrypi.org/documentation/installation/noobs.md> and follow the instructions to install NOOBS.

Insert the MicroSD card into the Raspberry Pi, and then connect the power, keyboard, mouse, and monitor to it.

Now, download the script `!!TODO!!` and run it from any directory. This will download and install all the source code and library dependencies for the project into `/home/pi/Documents/gearvr`.

If you run into any problems, here are some links that may help:

Phidgets Libraries for Linux: [http://www.phidgets.com/docs/OS\\_-\\_Linux](http://www.phidgets.com/docs/OS_-_Linux)

Phidgets Python SDK [http://www.phidgets.com/docs/Language\\_-\\_Python](http://www.phidgets.com/docs/Language_-_Python)

## 4.4 Test Software

Connect the PhidgetsStepper board to the Raspberry PI via the USB A to mini B cable. Now try the following tests:

### Test 1: Connection between Raspberry PI and PhidgetsStepper board

Navigate to `/home/pi/Documents/gearvr/lib/PhidgetsPythonExamples` and run the following:

```
sudo python HelloWorld.py
```

If the installation was successful, you should see the following output:

```
"Hello to Device Phidget Bipolar Stepper Controller 1-motor, Serial Number:
xxxxx"
```

### Test 2: Controlling the motor

Navigate to `/home/pi/Documents/gearvr/lib/PhidgetsPythonExamples` and run the following:

```
sudo python StepperSimple.py
```

If the installation was successful, then the motor should step to position 20000 and then back to 0.

### Test 3: Controlling the motor via bluetooth

On the Raspberry Pi, navigate to `/home/pi/Documents/gearvr` and run:

```
./main.sh
```

If working, the motor should become engaged. Now, on a different compute, open a terminal and navigate to the GazeContentigentFocus dropbox. Then navigate to the folder `gearvr/ble_testing` and type:

```
npm install
sudo node write-to-pi.js
```

If a bluetooth connection is established with the Raspberry PI, you will see the following output:

```
"found peripheral:  localName: ... "
```

Now test entering different motor positions to make sure you can control the motor.

## 4.5 Setup Boot Loader

Open a terminal and type:

```
sudo crontab -e
```

Then add the following line at the bottom:

```
@reboot sh /home/pi/Documents/gearvr/main.sh
```

This will ensure that every time you power on the Raspberry PI, it will automatically start the motor controller program. This is very convenient if you want to demo the GearVR in different places, because it means you don't need to carry around a keyboard, mouse, and monitor or SSH into the device.

## 5 Setup Motor Pulley

### 5.1 Parts

- Nema 17 bipolar stepper motor
- Nema 17 stepper motor mount + mounting screws
- 5mm Bore Set Screw Hub
- 2" I.D., 5mm bore v-belt pulley
- 2' 1/8" I.D., 2' 1/4" O.D., 1/16" width o-ring
- 4 6-32 machine screws + nuts
- Eye Tracking GearVR
- Miniature Screwdriver Set
- Scissors
- Super glue
- Double-sided tape

### 5.2 Installation

#### Step 1: Setup pulley

Install the motor to the motor mount using the mounting screws. Then, slide the v-belt pulley over the motor shaft followed by the set screw hub. Secure the set screw hub to the motor shaft via the set screw and secure the set screw hub to the v-belt pulley using the 6-32 machine screws + bolts.

Refer to figure 4.a for what the final pulley system should look like.





(a) Eye Tracking GearVR with Assembled Motor Pulley



(b) Nema 17 Stepper Motor Mount



(c) 5mm Bore Set Screw Hub



(d) 2" I.D., 5mm Bore V-belt Pulley

Figure 4: Motor Pulley Components

### **Step 2: Connect pulley to GearVR**

First, remove the outer part of the focus wheel on the GearVR.

Now, using scissors, cut the o-ring anywhere. Tape one end of the o-ring to the inside of the focus wheel (using a very small amount of tape) and then rotate the focus wheel so the o-ring wraps around the focus wheel. Now use super glue to re-glue the ends of the o-ring together.

Using double-sided tape, tape the motor mount onto the GearVR as shown in figure 4.a. Now, wrap the o-ring around the v-belt pulley.

## **6 Setup Phone**

### **6.1 Parts**

- Samsung S7 Phone
- USB A to A cable
- Game Controller

### **6.2 Installation**

First install the latest version of Unity onto your computer. Then, open the project contained in the folder gearvr/unity within the GazeContingentFocus dropbox folder. This project contains a demo scene wired up with all the necessary components to do eye-tracking and to communicate with the Raspberry PI to drive the motor. Feel free to test the scene in the editor first, and then upload it to the phone.

To test the scene, plug the phone into the GearVR. Make sure that the Raspberry PI and PhidgetsStepper board are powered on and the motor controller program is running on the Raspberry PI.