

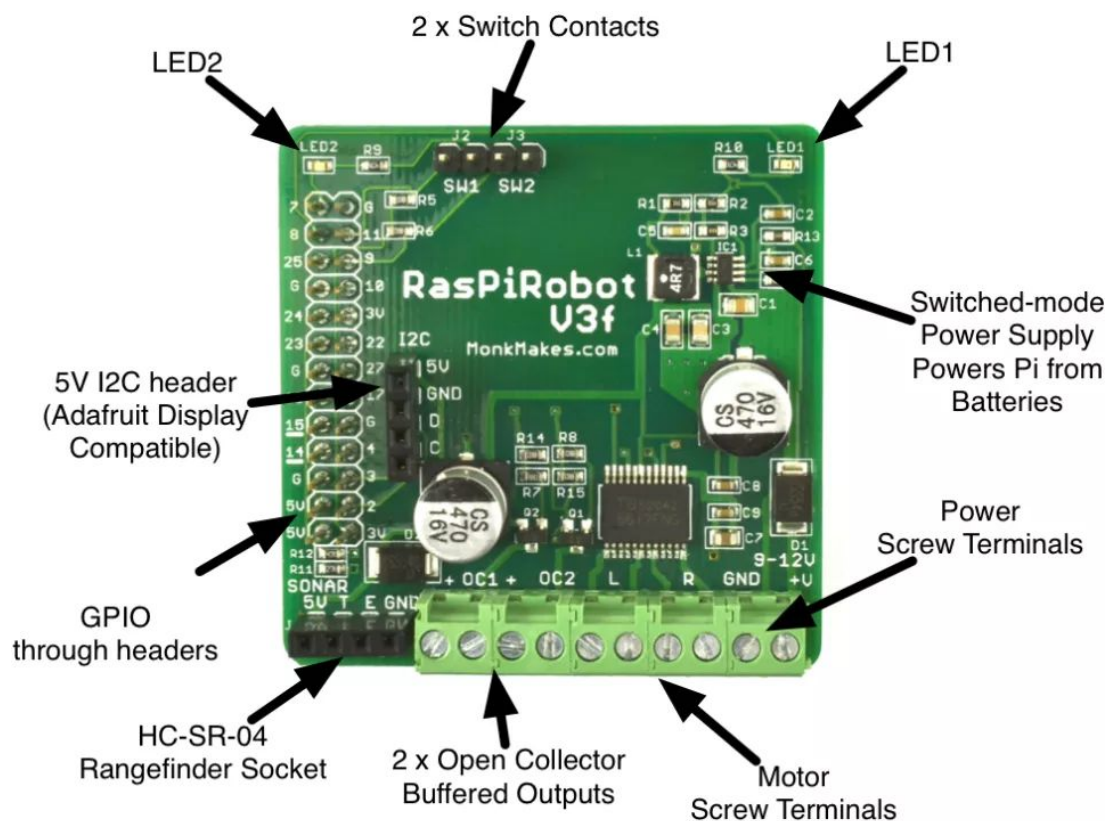
Robots I - Week 1

Robot Parts

It's all about the power...

Your Raspberry Pi is not powerful enough to power robot motors. At the same time, electronic circuits that include motors emit “dirty power” that is generally not safe for sensitive electronics - such as our Raspberry Pi. We will power our robot with two power sources (1) for the Raspberry Pi and (2) for the robot shield and motors.

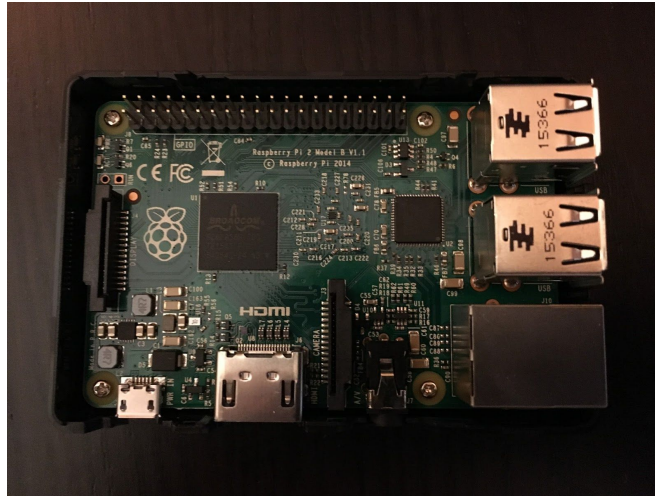
RasPi Robot HAT



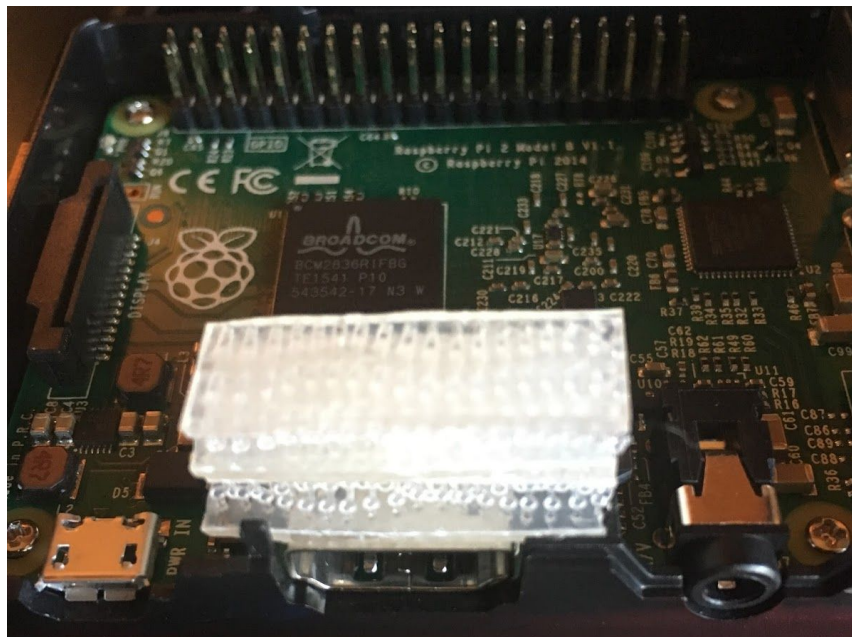
This class will introduce the RasPi Robot HAT (**H**ardware **A**ttached on **T**op). The Robot HAT is a special board that sits on top of the GPIO pins and allows for the Pi to turn into a robot. The HAT has a number special features that we will explore over the course of the next few weeks.

Installing the HAT

Let's get started by removing the top part of our case and (carefully) the T-Cobbler ribbon cable. When we are done, our Pi will look like the picture to the right.

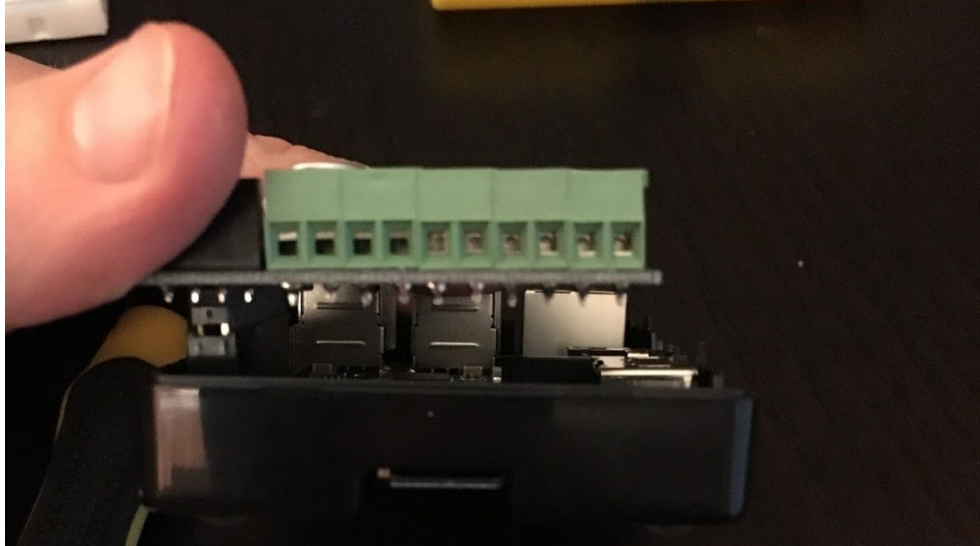


Next, with the HDMI plug facing us, we want to insert a small amount of velcro that will create a buffer from the HAT to the Pi. We do not want the HAT to ever touch the Pi outside of the GPIO pins. This will create a short circuit.

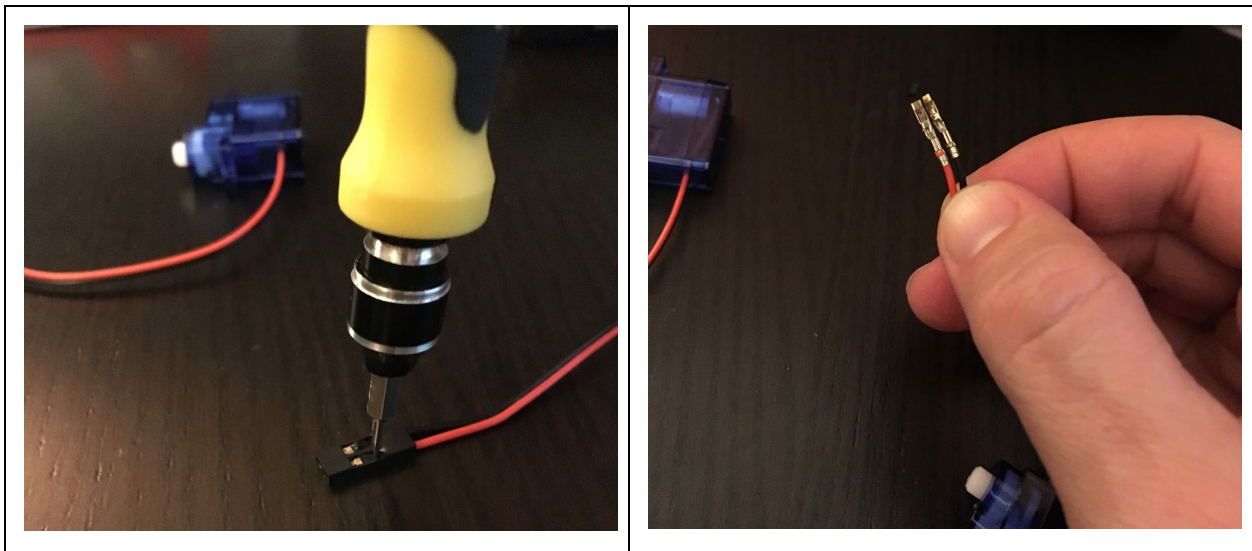




Next seat the HAT to the far left of the pins and carefully push down on either side of the HAT.



Using a small screw driver, completely loosen the right six screws. Doing so will drop a metal clamp that will connect the batteries and motors.



Using a small flat head screwdriver bit, carefully push down and remove the plastic coverings for the each motor. This will expose a small metal clamp.

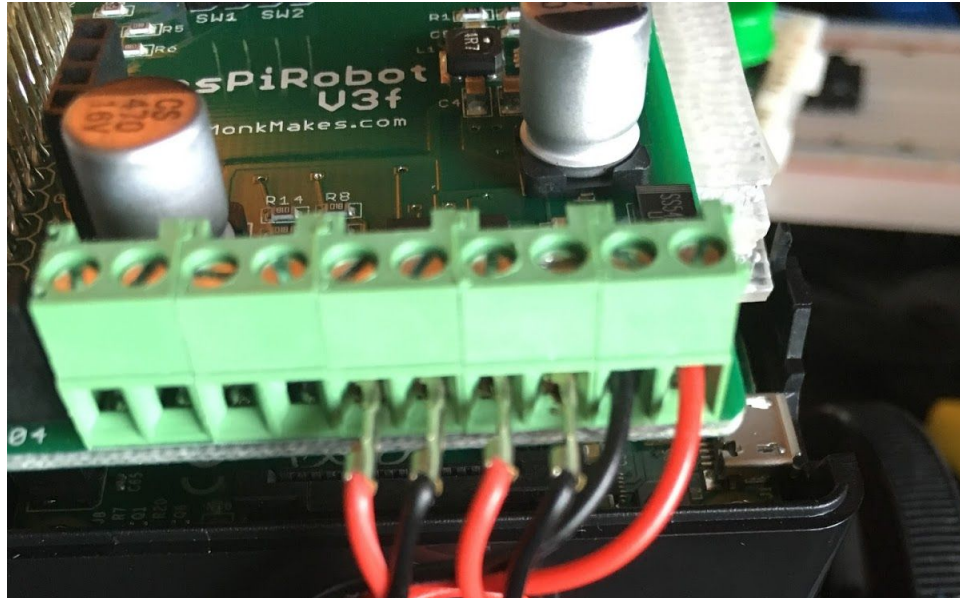
Install 4 AA batteries in the battery holder and replace the battery cover. Make sure battery switch is on the “OFF” position.



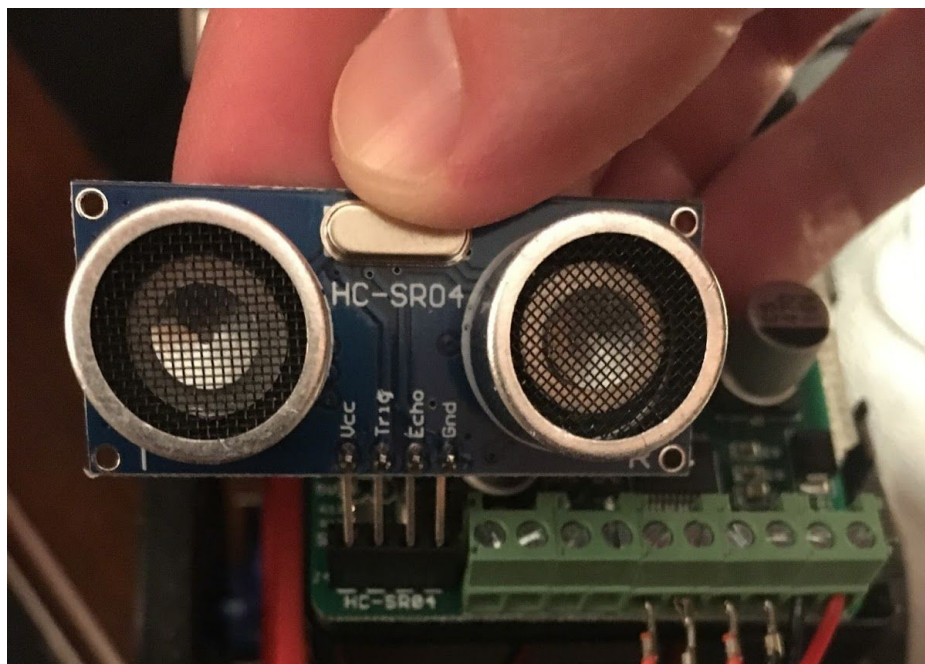
Install the left and right motor leads using the pattern in the below picture.



Install the battery pack heads using the pattern in the below picture.



And finally, drop the ultrasonic sensor in place:



Power Up Your Pi

It's time to power up your Raspberry Pi. You'll want to connect things in this order:

1. HDMI Video cable
2. Ethernet cable (network)
3. Micro USB power
4. Keyboard FOB
5. Turn on robot battery pack

RasPi Robot - Python Setup

The RasPi Robot provides a complete python library so we can code our robot using our favorite language. Before we can start coding, we need to install the rrb3 python library. This can be done with the following command:

```
pi@predicate:~ $ sudo pip install rrb3
```

You can tell that this command completed successfully if you see the following output when running your command:

```
Successfully installed rrb3
```

RasPi Robot - Python Control

Now we are ready to take our new hardware for a test drive. Here are some examples to test that everything is working. Type these into an IDLE window. Save each example into a separate file in your code directory.

Robot LED

```
from rrb3 import *
import time

rr = RRB3(6, 6)
for x in range(25):
    rr.set_led1(1)
    rr.set_led2(1)
    time.sleep(0.1)
    rr.set_led1(0)
    rr.set_led2(0)
    time.sleep(0.1)
```

Range Finder

The rangefinder measures distances in centimeters. Run this code and then try moving some objects around to see the resulting impact on the distance measurements.

```
from rrb3 import *
import time

rr = RRB3(6,6)
try:
    while True:
        distance = rr.get_distance()
        print(distance)
        time.sleep(0.2)
finally:
    print("Exiting")
    rr.cleanup()
```

Motor Control

```
from rrb3 import *
from random import randint

rr = RRB3(6, 6)
# forward forever
rr.forward()
time.sleep(5)
rr.stop()

# reverse forever
rr.reverse()
time.sleep(5)
rr.stop()

# forward for 5 seconds
rr.foward(5)

# reverse for 5 seconds
rr.reverse(5)

# forward for 5 seconds (full speed)
rr.forward(5, 1)

# reverse for 5 seconds (full speed)
rr.reverse(5, 1)
```



```
# another way of saying forward at full speed
# change the 0s to 1s to reverse motors
# change the 1s to 0.5 for half speed
# can you just run one motor?
rr.set_motors(1, 0, 1, 0)
time.sleep(5)
rr.stop()
```

Crazy Motors

What does this code do?

```
rr = RRB3(6, 6)

i = 0

while True:
    speedl = randint(0, 100) / 100.0
    speedr = randint(0, 100) / 100.0
    dl = randint(0, 1)
    dr = randint(0, 1)
    rr.set_motors(speedl, dl, speedr, dr)
    time.sleep(3)
    i += 1
    print(i)
```