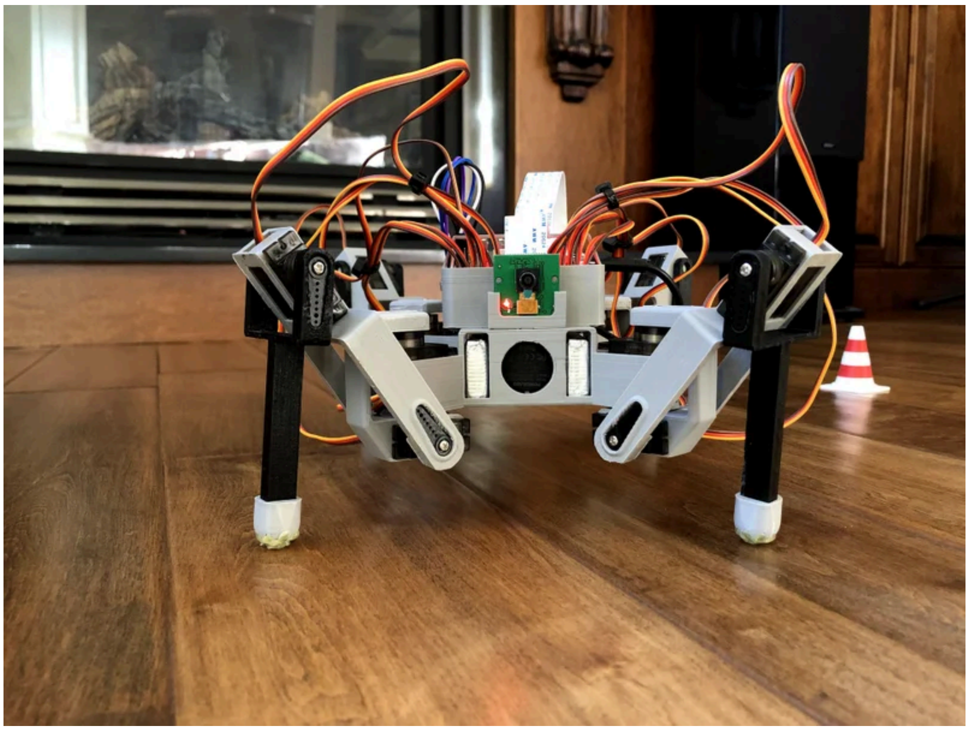
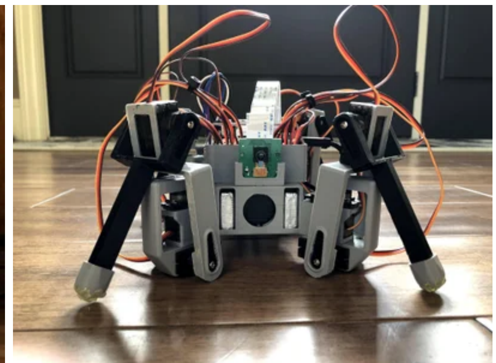
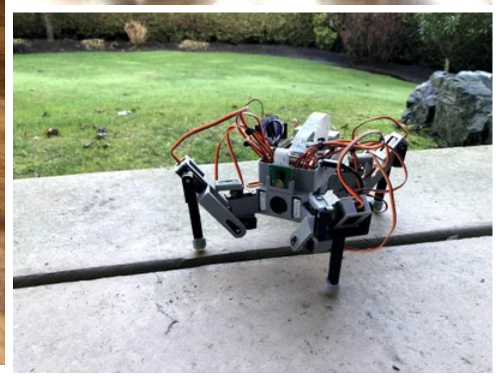
3D Printed Raspberry Pi Spider Robot Platform

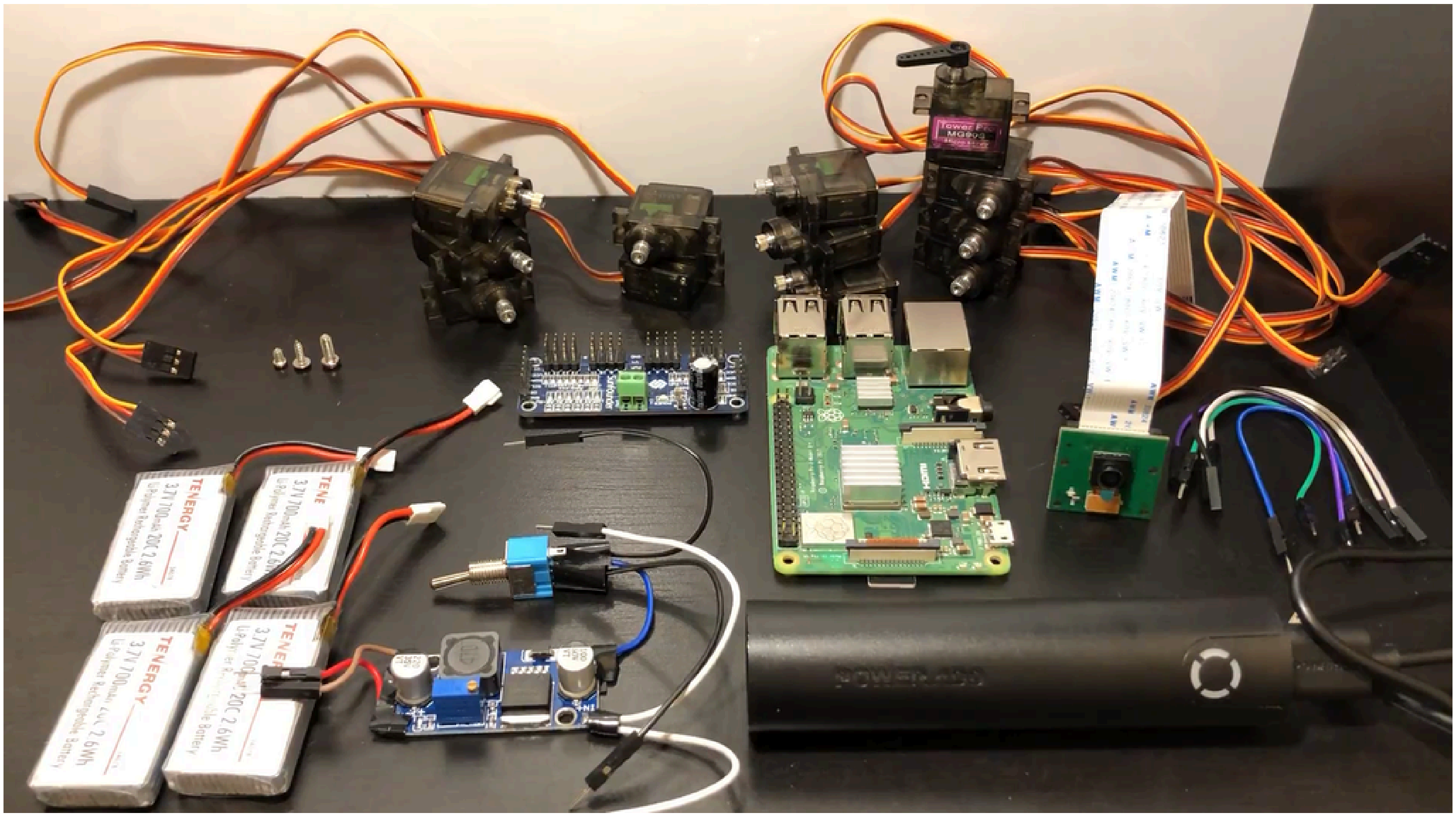
By Morrisl4 in CircuitsRobots

Introduction: 3D Printed Raspberry Pi Spider Robot Platform

This is a fun beginner project for anyone to make! It is a four legged spider robot platform using Raspberry Pi as the brain, 3D printed parts as the body, and many readily available electronics from amazon or banggood. No custom PCB is required. With step-by-step video guides it is a good project for anyone who wants to tinker with Raspberry Pi, Python programming, 3D printing, and robotics.

Step 1: Supplies



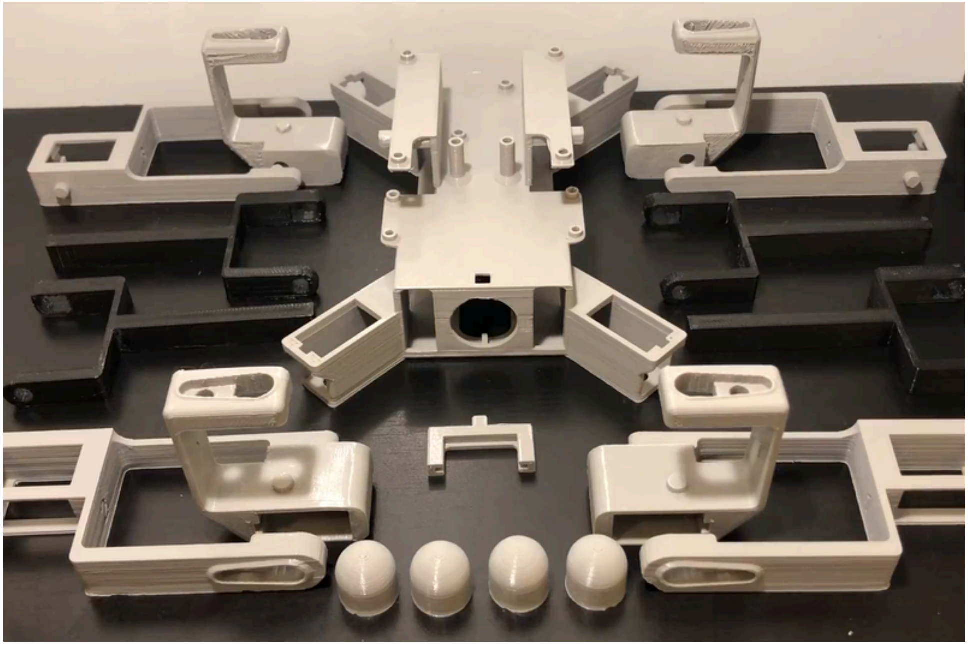
As mentioned above all of the electronics are readily available on Amazon or Banggood or even your local hobby store. Here is the bill of materials with links provided for you to make this robot:

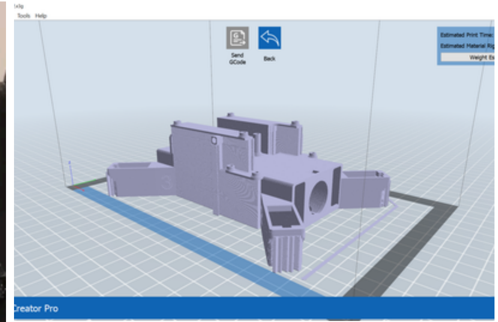
- 1 x Raspberry Pi 3B+ .... Amazon // Banggood
- 1 x 5MP OV5647 Pi camera module .... Amazon // Banggood
- 1 x POWERADD 5000mAh Power Bank (needs to be this one or similar size)
- 1 x PCA9685 16 Channel 12 Bit PWM Servo Driver .... Amazon // Banggood
- 1 x LM2596 Buck Converter, DC-DC step down module .... Amazon // Banggood
- 12 x MG90S Servo motor .... Amazon // Banggood
- 4 x Lipo 3.7v battery .... Amazon // Banggood (if you are unable to get this battery then get a similar size one with capacity around 700mAh)
- 1 x Toggle Switch .... Amazon // Banggood
- Some Jumper wires .... Amazon // Banggood
- Some M3 nuts & bolts .... Amazon // Banggood

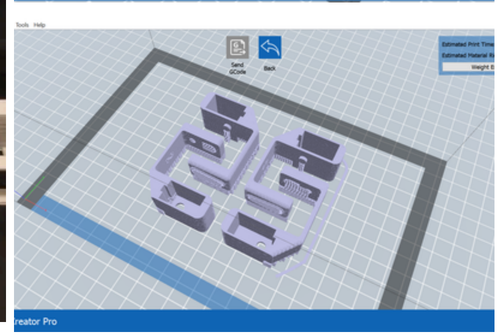
You will need a 3D printer or access to 3D printer to print the body parts of the robot. I can recommend the 3D printer that I use, this one is a real workhorse: https://www.flashforge.com/product-detail/4

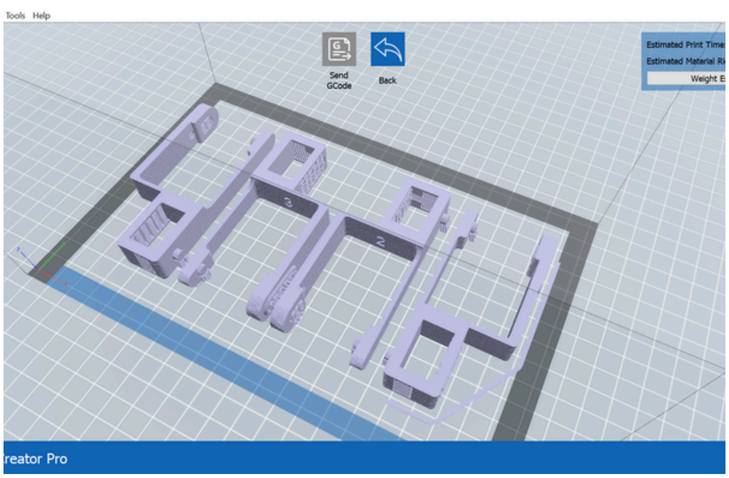
Additional tools that you will need: soldering iron, heat shrink tubes, electrical tape, zip tie, pliers, hot glue gun, and screwdriver.

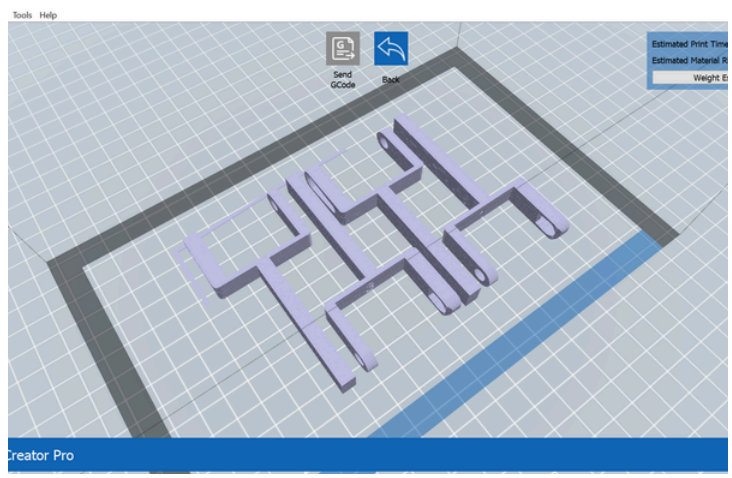
Step 2: Print 3D Printed Parts











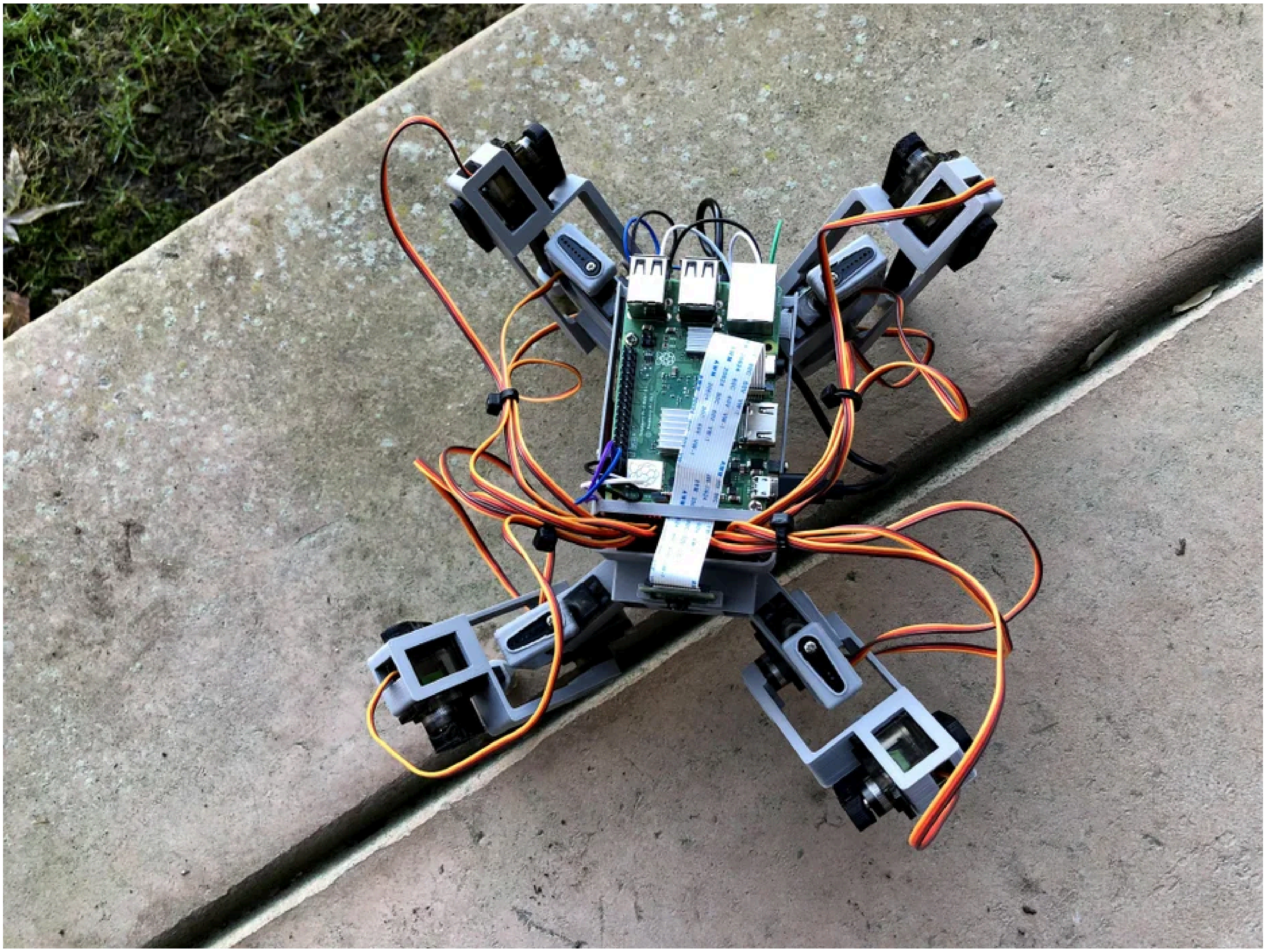
List of parts needed to be printed:

- 1 x Body
- 1 x Joint 1
- 1 x Joint 2
- 1 x Joint 3
- 1 x Joint 4
- 1 x Thigh 1
- 1 x Thigh 2
- 1 x Thigh 3
- 1 x Thigh 4
- 1 x Calf 1
- 1 x Calf 2
- 1 x Calf 3
- 1 x Calf 4
- 1 x Pi camera mount
- 1 x Cover
- 4 x Tip (glue)
- 4 x Tip (smooth)

Each leg is has three components: joint, thigh, and calf. For ease of assembly all components of a leg are numbered. All parts can be printed using PLA. You can print all the Joint parts together in one go and same for Thigh parts and Calf parts as shown in the picture. Supports are needed for Body, Joints, Thighs, Pi camera mount, and Cover.

If parts don't fit together properly feel free to change the dimensions of any part.

Step 3: Raspberry Pi Setup



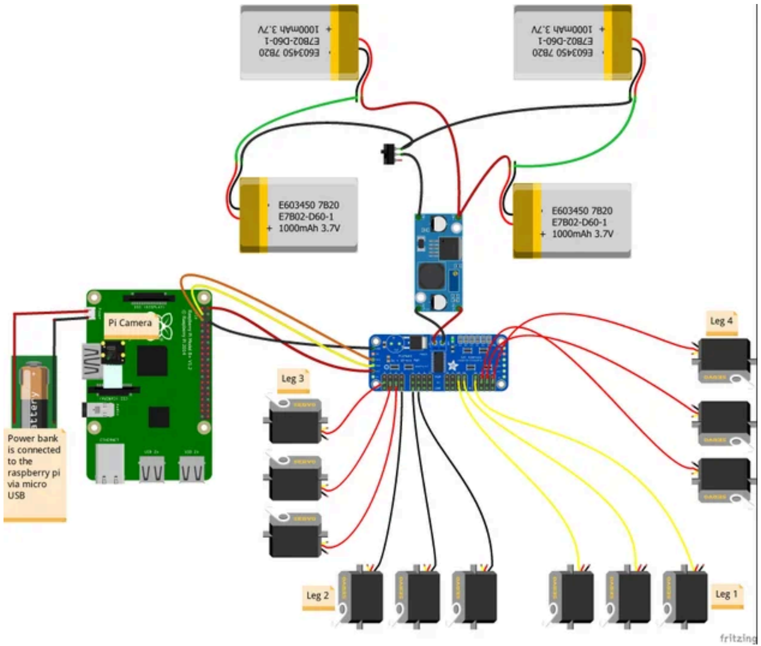
This Raspberry Pi setup video is for setting up a headless Raspberry Pi and accessing the Pi using a laptop via VNC. You need a power supply for the pi, micro SD card, microSD card to SD card adapter or USB microSD card reader and obviously a laptop. All these components should come with the canakit from the Raspberry Pi 3B+ link provided in step 1. You can also do this with a desktop computer as well. Keep in mind there are other ways to setup a Raspberry pi do whatever you are most comfortable with. My setup is more economical compare to the regular setup.

If your Raspberry Pi is not running properly open command line and type these two lines: "sudo apt update" and "sudo apt full-upgrade"

Here are all the software links to complete this step:

- Raspberry Pi Imager: https://www.raspberrypi.org/software/
- Putty: https://www.putty.org/
- Advanced IP Scanner: https://www.advanced-ip-scanner.com/
- VNC: https://www.realvnc.com/en/connect/download/viewer/

Step 4: Assembly of the Robot



Wiring table for servo motors to PCA9685 servo driver	
Servo Motors	PCA9685
Calf 3	0
Thigh 3	1
Joint 3	2
Calf 2	3
Thigh 2	4
Joint 2	5
Joint 1	10
Thigh 1	11
Calf 1	12
Joint 4	13
Thigh 4	14
Calf 4	15

Wiring table for raspberry pi to PCA9685 servo driver	
PCA9685	Raspberry Pi
SCA	GPIO 2
SDL	GPIO 3
VCC	5V
GND	GND

The assembly video guide can be split into two parts. First part is hooking up the circuit to test servo motors. Second is the assembly of the robot. Some sanding of the 3D printed parts might be needed in order to fit some parts together. Keep in mind the video is a guide, you can switch up the order of assembly if you want, however, you should always test the circuit first.

Wiring diagram and table are provided. I did not show the complete wire up of servo motors in the diagram, because it will be too messy. The wiring table gives a batter idea. On where each servos should be connected to the ports of the PCA9685 servo driver. To give an example on how to read the table, first row reads Calf 3 to 0. This mean the servo motor that controls Calf 3 (the 3D printed part) connects to the 0 port on PCA9685.

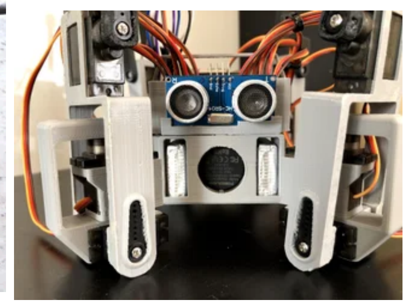
If you are curious on how the four li-po batteries are connected. They are a set of two 3.7v li-po batteries in series, which makes it a 7.4v battery pack. Then it is connected by another identical set in parallel. Each li-po battery has a 700mAh capacity. This makes it a 7.4v 1400mAh batter pack. Putting batteries in series will add up the voltage. While putting batteries in parallel will add up the capacity. Side note, there are two power sources on this robot the li-po battery pack is for powering the servo motor. While the power bank is for powering the Raspberry Pi.

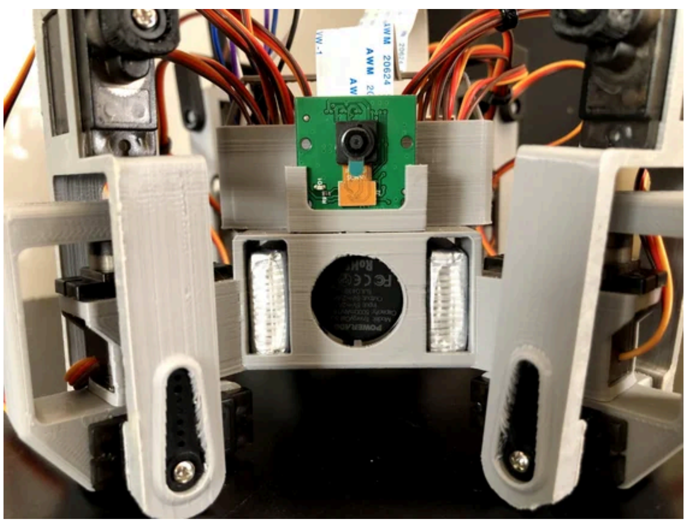
Here are all the software links and command lines to do this step:

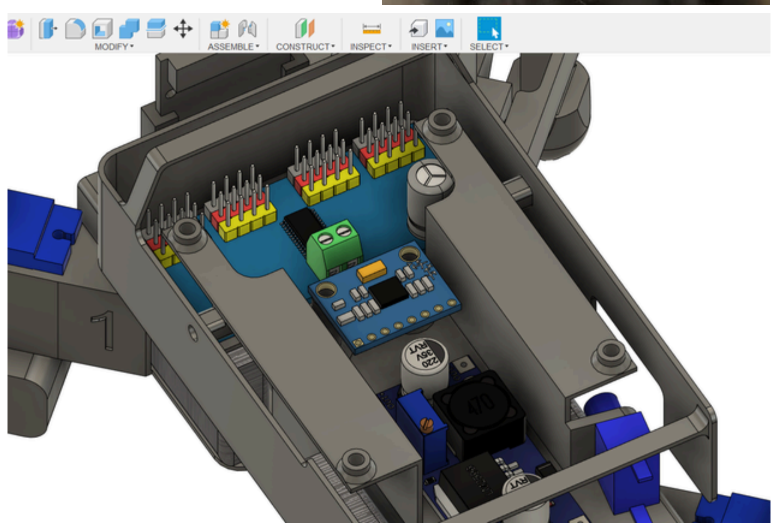
- WinSCP: https://winscp.net/eng/download.php
- Adafruit_Python_PCA9685 module: “sudo pip3 install adafruit-pca9685”
- Pygame module: "sudo pip3 install pygame"

Step 5: Play! and the Possibilities:)

Action	Key
Move robot forward by trotting	W
Rotate robot counterclockwise	A
Rotate robot clockwise	S
Move robot backward by trotting	D
Move robot to the right by trotting	Q
Move robot to the left by trotting	E
Saying Hi	Space
Move robot forward by creep gait	T
Move robot backward by creep gait	G
Shuffling	C
Humping	V
Squading from all sides	B
Take a picture and save image to desktop	J
Camera preview on	I
Camera preview off	K
Start camera recording with preview on	O
End camera recording and save video to desktop	L
End the robot program	Backspace







Congrats!! on building a four legged spider robot. To operate it there is a picture of the keyboard control provided. Hope you learn something and have fun!

The possibilities to expand and upgrade this robot is endless. For example, I have included a HC-SR04, ultrasonic sensor mount in step 2 so you can make the robot walk by itself with some additional code. I also included a place to mount a MPU-6050 sensor on the Body (picture provided) with some additional code you can make the robot self-stabilizing. Moreover, you can switch the Pi 3B+ to a Raspberry Pi 4 to gain more computing power. Then you can use OpenCV to let the robot have computer vision for stuff like face detection and object detection. Your imagination and ability are the limit ;)

Please like and subscribe my videos I am building a youtube channel:
https://www.youtube.com/channel/UCFj6tFPxIVaNm1r6...

Feel free to ask any questions about the project