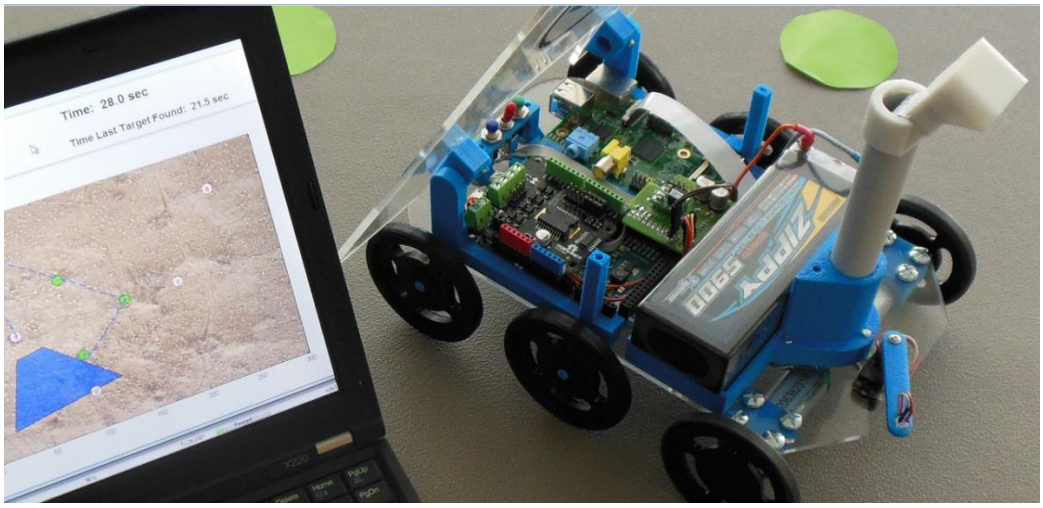
MathWorks Mars Rover

Hardware Bill of Materials (BOM) and Assembly Guide



Description	Author	Date
Preliminary Release	Paul Cox	Nov 2014
Added Assembly Guide	Paul Cox	Jan 2015

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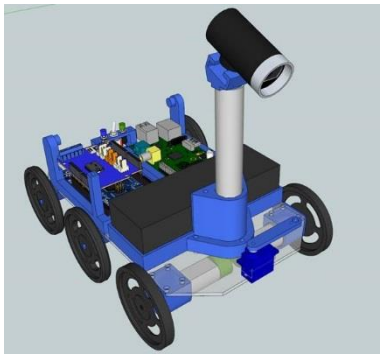
Introduction



The Mars Rover hardware design was initially developed by Paul Cox and Pascal Langer of MathWorks France for the Maker Faire Paris 2014 event for a robot competition where MW provided 12 robots to 12 teams. The 2015 competition adds an IR sensor for obstacle detection.

This document lists the individual components necessary to build the vehicle. A separate document details the build procedure. A third document details testing the completed robot. A fourth document details the complete competition setup.

Keep in mind that the hardware design includes provisions for future improvements (for example using the cheaper raspberry pi camera instead of the Microsoft USB LifeCam) and a number of problems (for example the wiring on the servo header is not standard).

Mechanical and Electromechanical Components

Motor with Encoder (1:53 ratio)

- Source: Digilent (US) or Lextronic (France)
- Link: https://www.digilentinc.com/Products/Detail.cfm?NavPath=2,403,625&Prod=MT-MOTOR
- Cost:

Wheels

- Source:
- Link: https://www.digilentinc.com/Products/Detail.cfm?NavPath=2,403,621&Prod=MT-WHEELKIT
- Cost:

Tires

- Source:
- Link: https://www.digilentinc.com/Products/Detail.cfm?NavPath=2,403,1002&Prod=MT-STICKY-TIRES
- Cost:

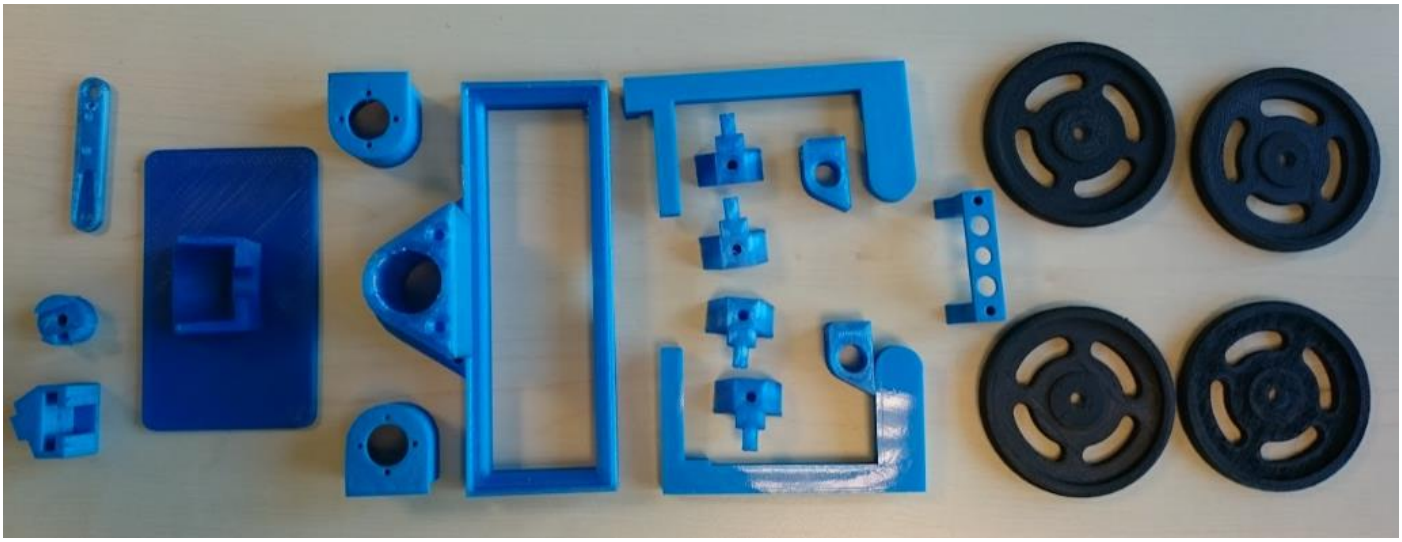
Rear Wheel

- Source: Radiospares
- Link: http://radiospares-fr.rs-online.com/web/p/billes-porteuses/0687635/
- Cost: 3.53 euros

Screws

- Description: M4 of various lengths :
  - 8x 10mm
  - 4x 20mm
  - 4x 30mm
  - 8x washers
- Source: Local hardware store
- Cost:

3D Printed Parts



- Source: Print from 3D model
- Cost:

Laser Cut Parts

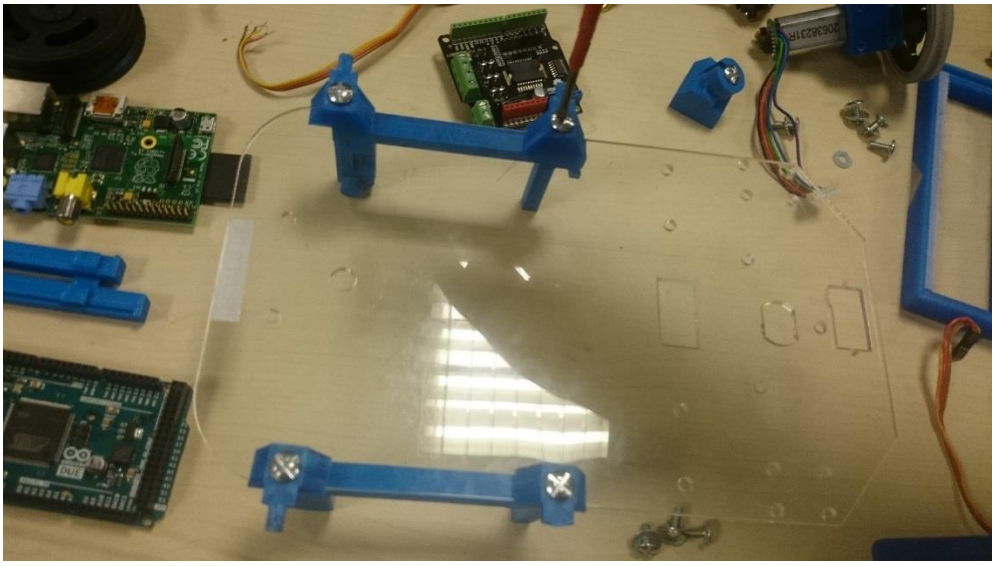
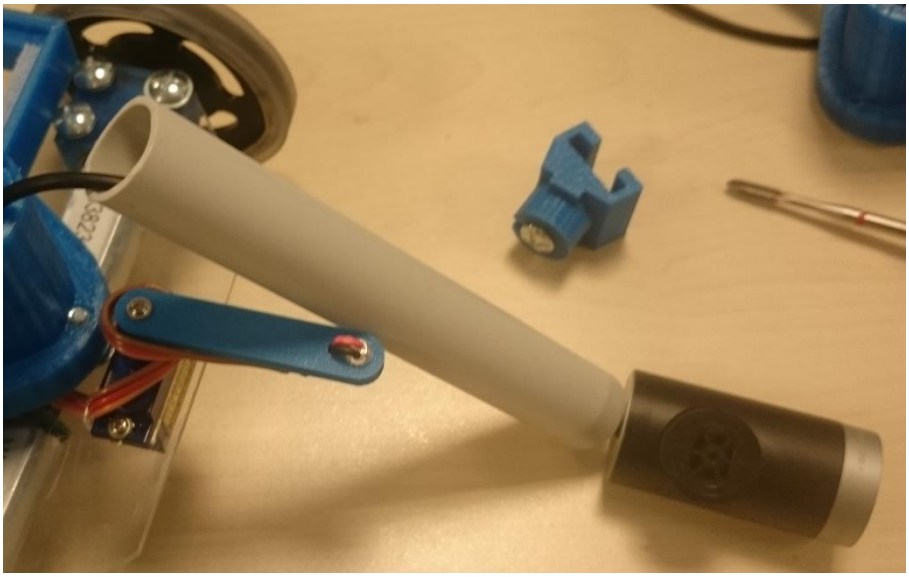


Figure 1 - Bottom Laser Cut Acrylic Plate

Figure 2- Top Laser Cut Acrylic Plate

Camera Tube

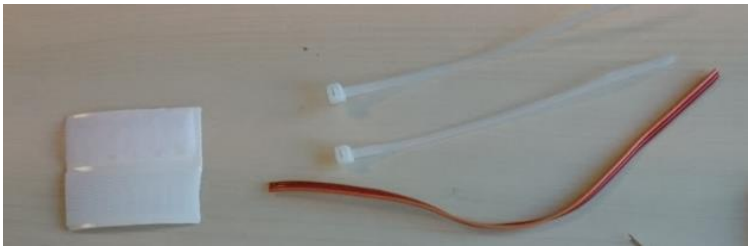


20 mm outside diameter, 13.5 cm length

Often sold as electrical conduit at the hardware store

Extra Parts

Wire, zip ties, Velcro



Mini Servo (optional)

- Source:
- Link:
- Cost:

Electric and Electronic Components

Arduino DUE

- Source:
- Link: http://www.amazon.fr/ARDUINO-A000062-Arduino-Due-Microcontr%C3%B4leur/dp/B00A6C3JN2/ref=sr_1_1?ie=UTF8&qid=1395395330&sr=8-1&keywords=arduino+due
- Cost:

Arduino or DFRobot Motor Shield

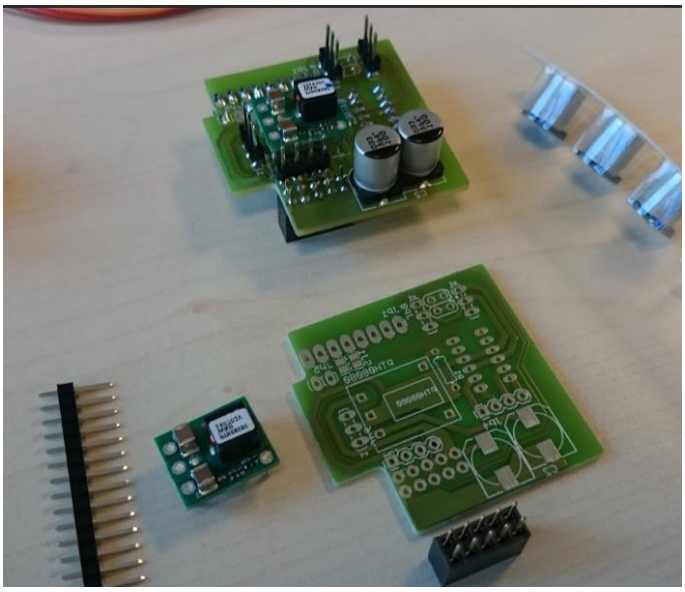
- Source:
- Link: http://www.gotronic.fr/art-shield-motor-dri0009-2-x-2-a-19345.htm
- Cost:

Raspberry Pi Model B

- Source:
- Link: http://www.amazon.fr/Raspberry-Pi-RBCA000-Carte-1176JZF-S/dp/B008PT4GGC/ref=sr_1_1?ie=UTF8&qid=1395395292&sr=8-1&keywords=raspberry+pi
- Cost:

SD Card

Power Supply Board



PSB Bill of Materials

QTY	Description	Link
1	Custom PCB	Design file from Eagle PCB software available and can be sent to any fab house
2	Motor connector	http://radiospares-fr.rs-online.com/web/p/embases-de-circuit-imprime/5468912/
1	5V regulator TI PTH08080	http://radiospares-fr.rs-online.com/web/p/modules-dalimentation-dc-dc/6617948/
2	100 uF Capacitor	http://radiospares-fr.rs-online.com/web/p/condensateurs-aluminium/5370613/

2	single row breakaway header male 0.1"	http://radiospares-fr.rs-online.com/web/p/embases-de-circuit-imprime/0156134/
1	2x5 female header 0.1"	http://radiospares-fr.rs-online.com/web/p/fiches-femelles-pour-ci/7655657/
1	300 Ohm 1% resistor	http://radiospares-fr.rs-online.com/web/p/resistances-traversantes/6834196/
2		

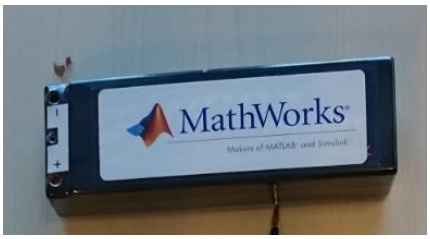
Pushbutton

Toggle switch

USB Camera

http://www.amazon.fr/Microsoft-LifeCam-Cinema-Webcam-filaire/dp/B002J1G4K8/ref=sr_1_3?ie=UTF8&qid=1395399594&sr=8-3&keywords=microsoft+lifecam

Battery



Description: 2S LiPo (Lithium Polymer) Hard Case, Capacity ~5900 mAh

Source: Hobbyking.com

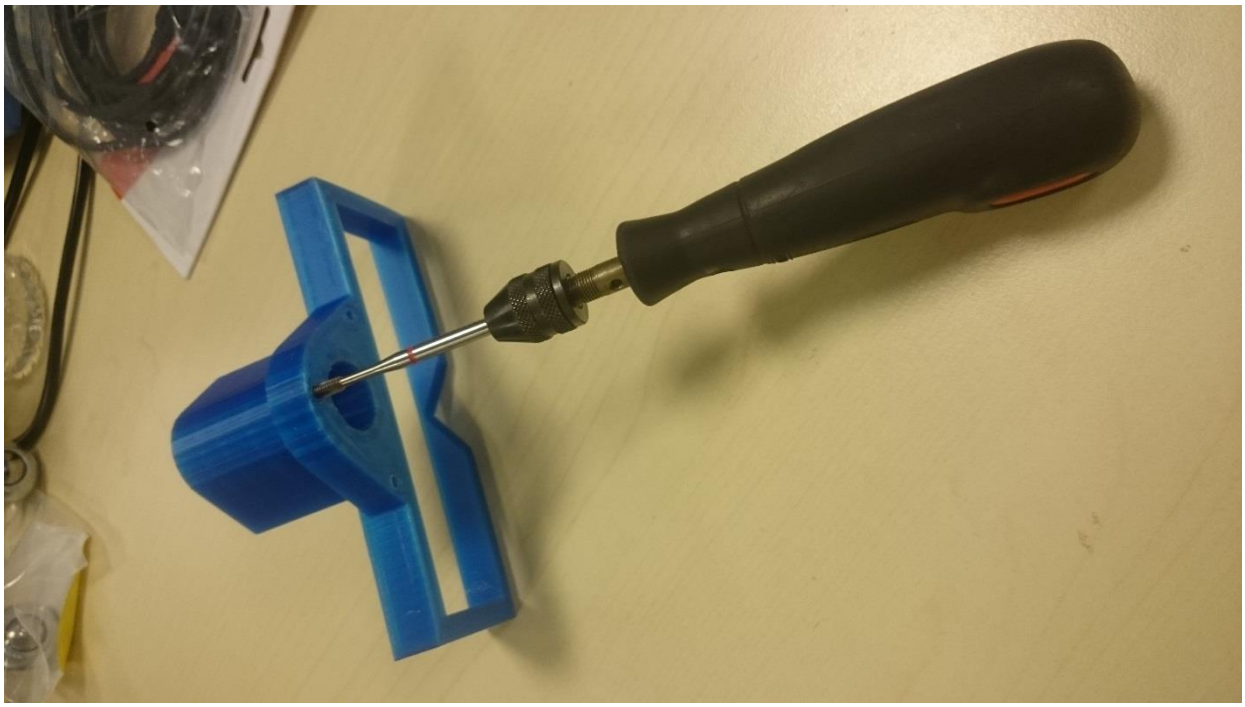
Link : http://www.hobbyking.com/hobbyking/store/uh_viewItem.asp?idProduct=38341

Charger

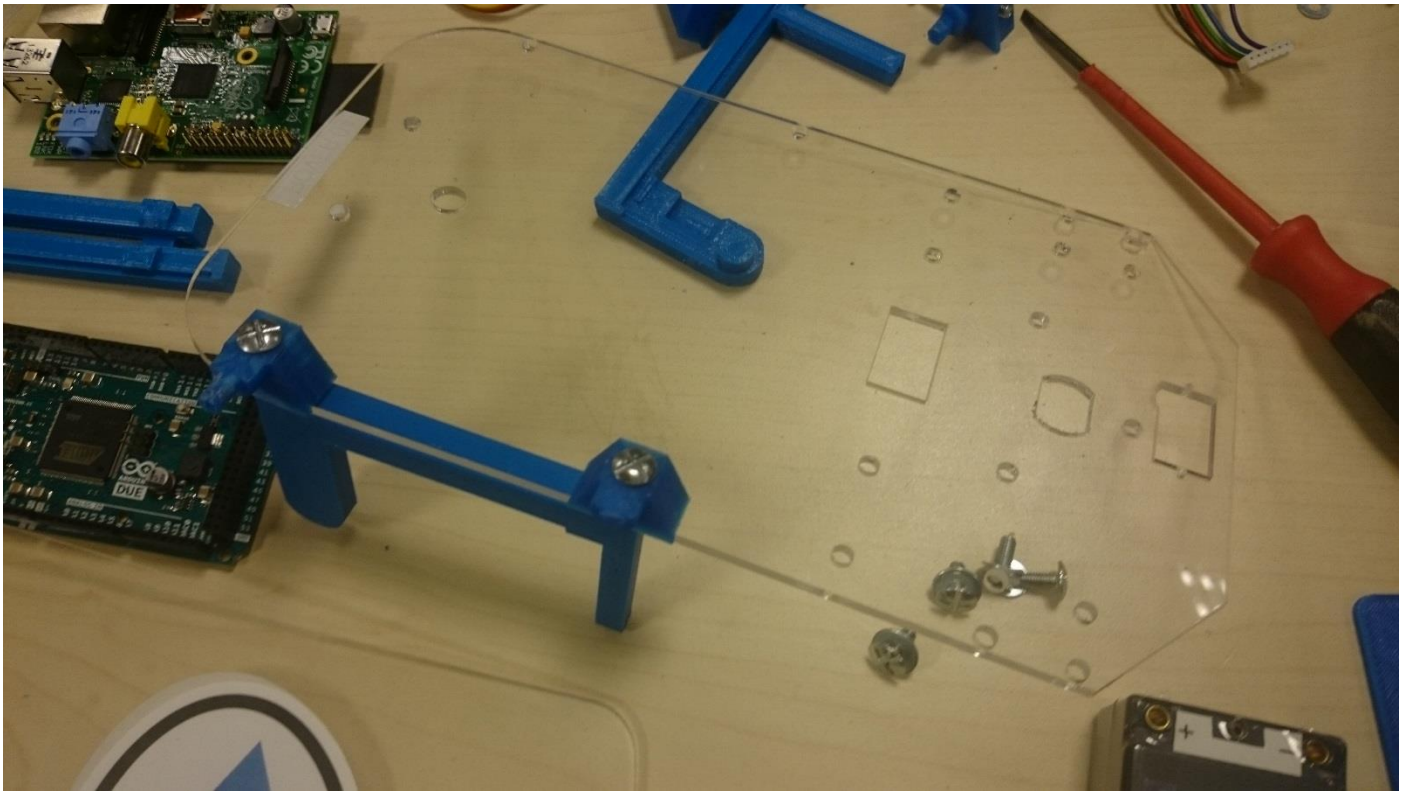
- Description: Accucel 6 LiPo charger
- Requires: two banana plug jumper wires, and 12-18 V DC power supply with barrel connector (old IBM laptop chargers work perfect)
- Link : http://www.hobbyking.com/hobbyking/store/__7028__Turnigy_Accucel_6_50W_6A_Balancer_Charger_w_Accessories.html

Rover Assembly Guide

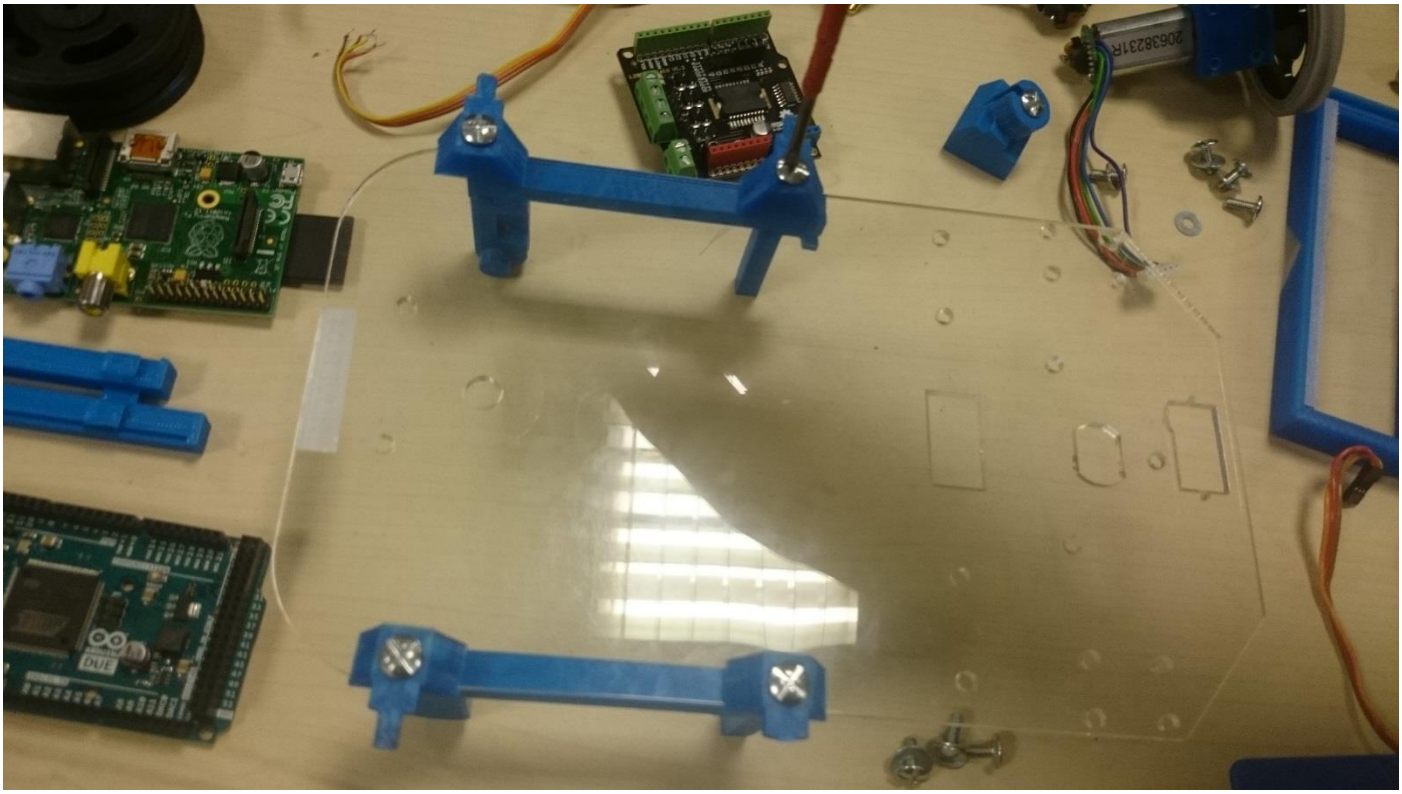
1. All 3D printed parts have holes that need to be threaded for the screws. The threading is accomplished by the means of an M4 tap as follows:



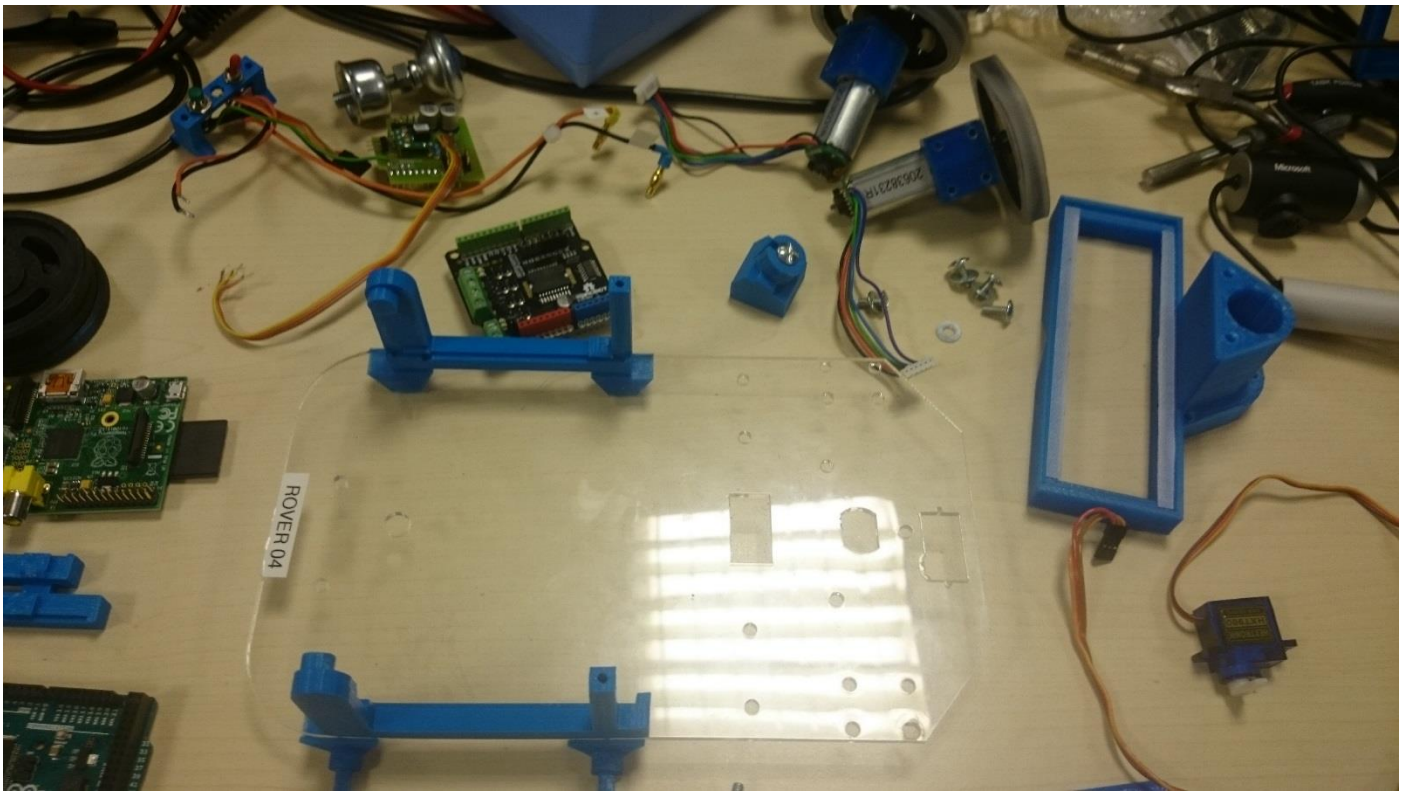
2. Start the assembly by screwing one of the side printed parts to the bottom plate using the two fictive wheel mounts and two long 30mm screws:



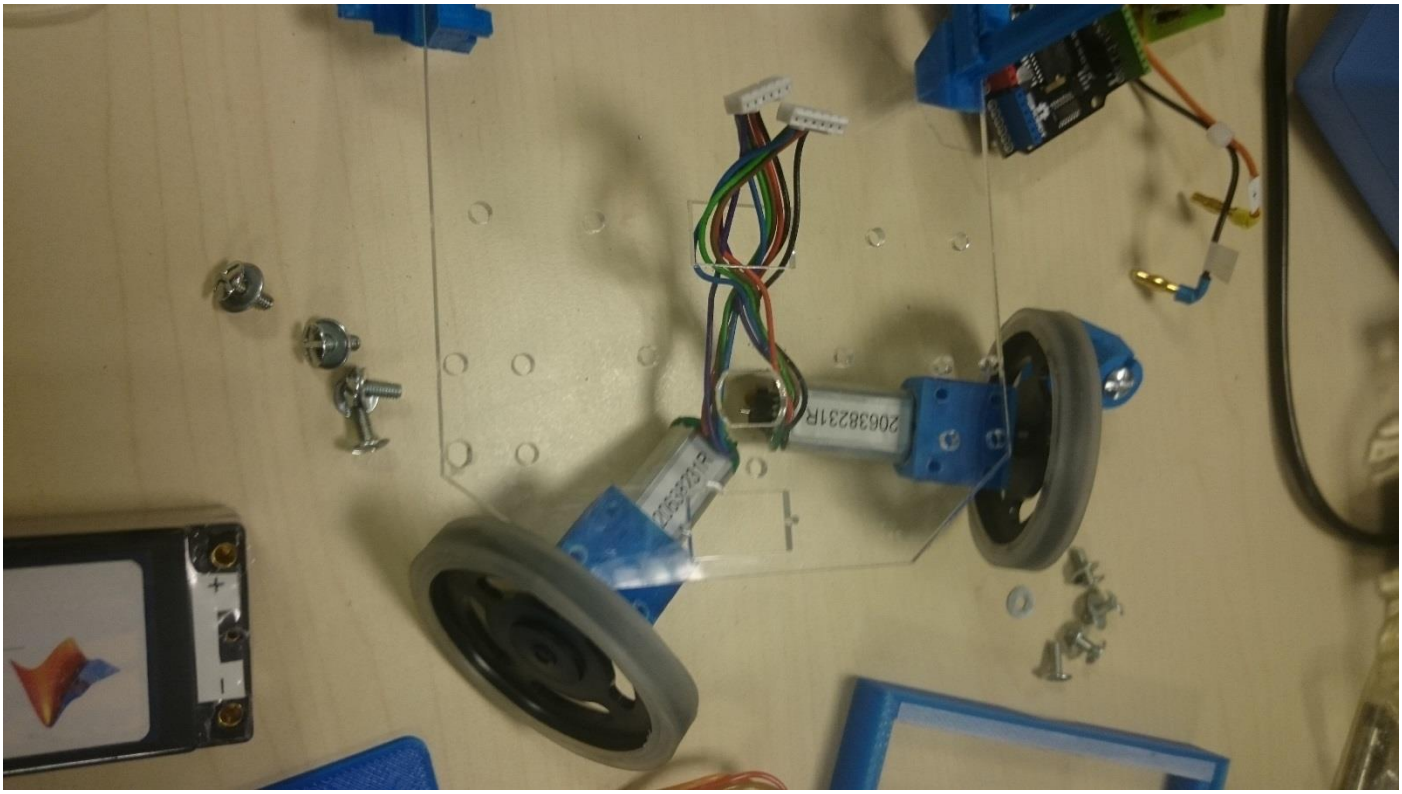
3. Do the same to the other side:



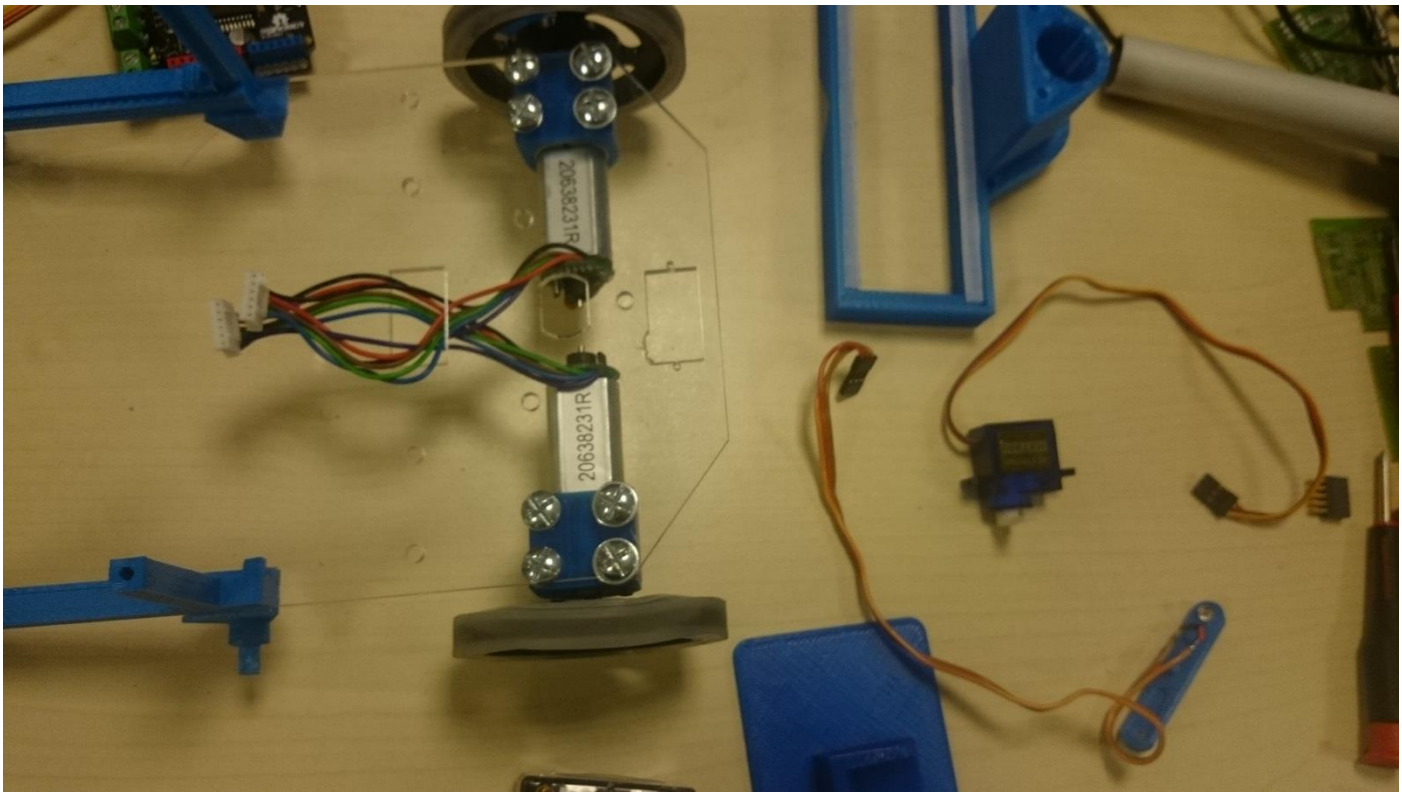
4. Flip it over



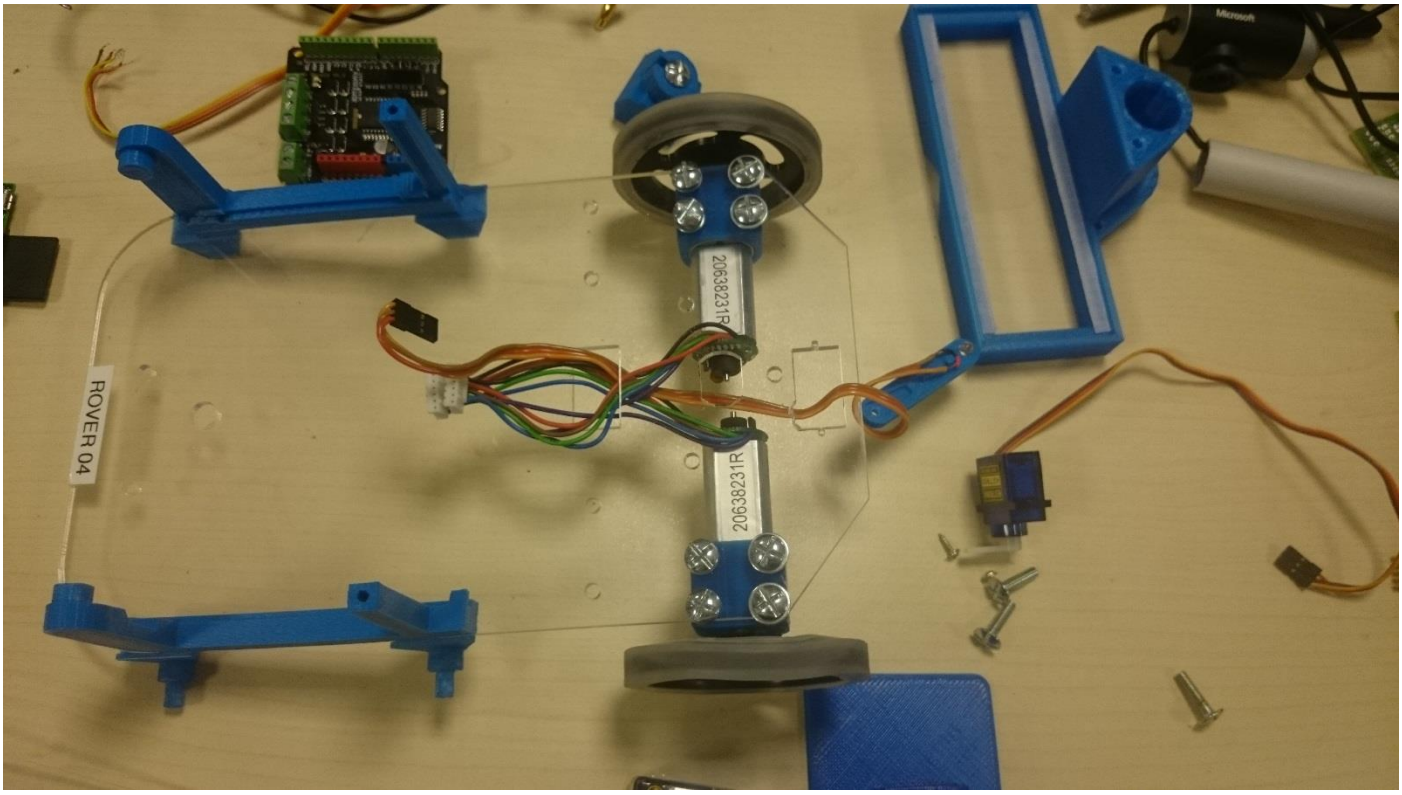
5. Insert the motors into their mounts and screw them in, add the wheels and tires, and thread the motor wires through the bottom acrylic plate:



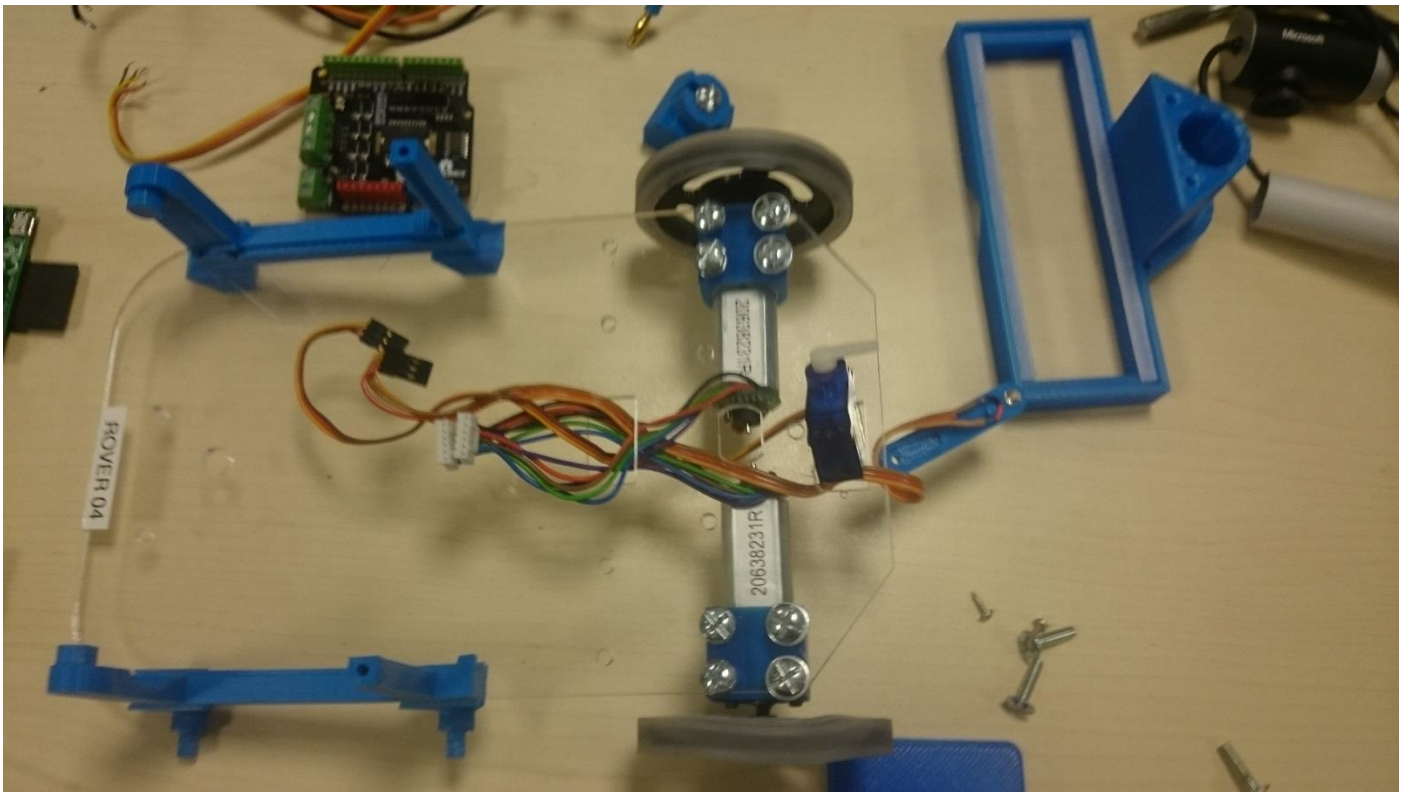
6. Screw the motor mounts into the acrylic plate using 8x 10mm m4 screws



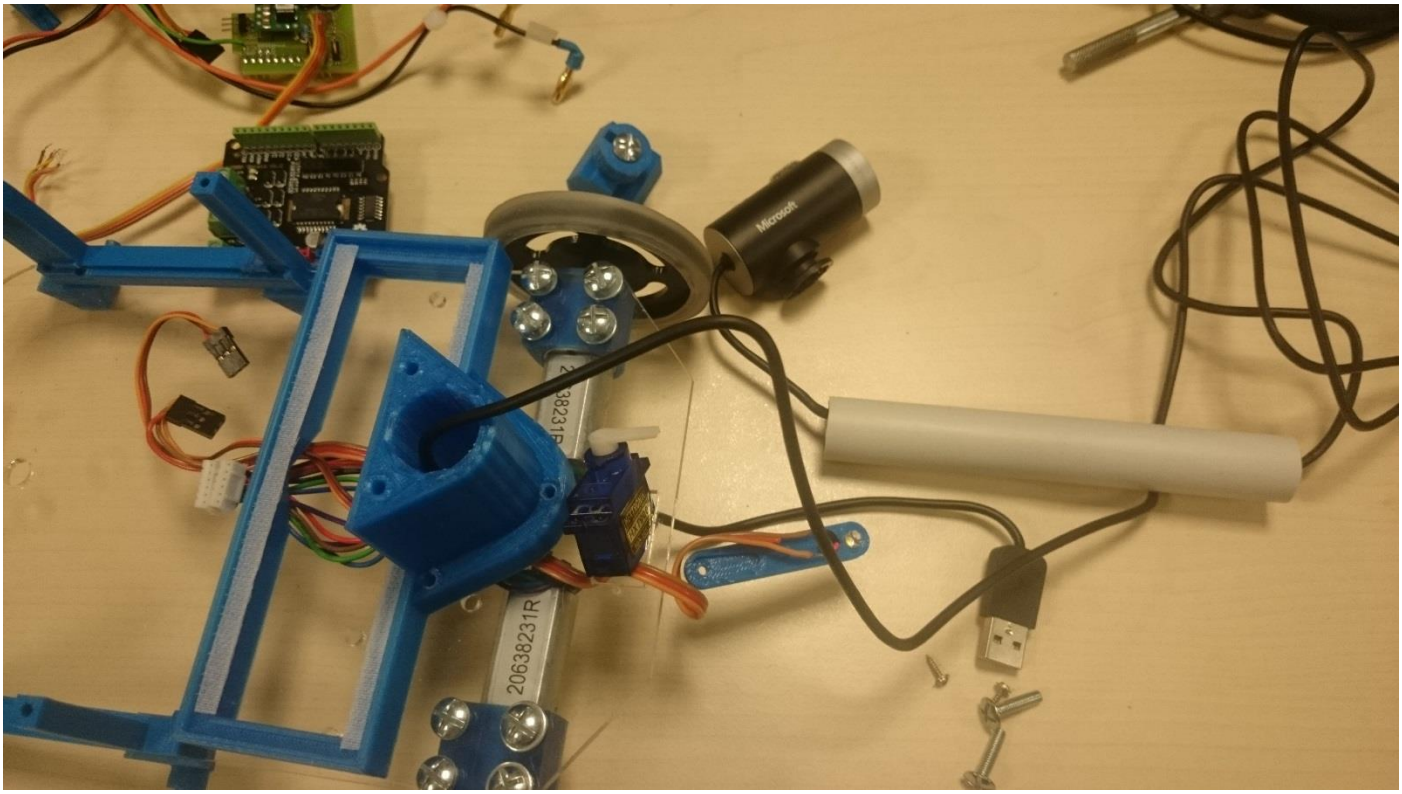
7. Thread the wires for the led/IR sensor through the acrylic plate holes as shown



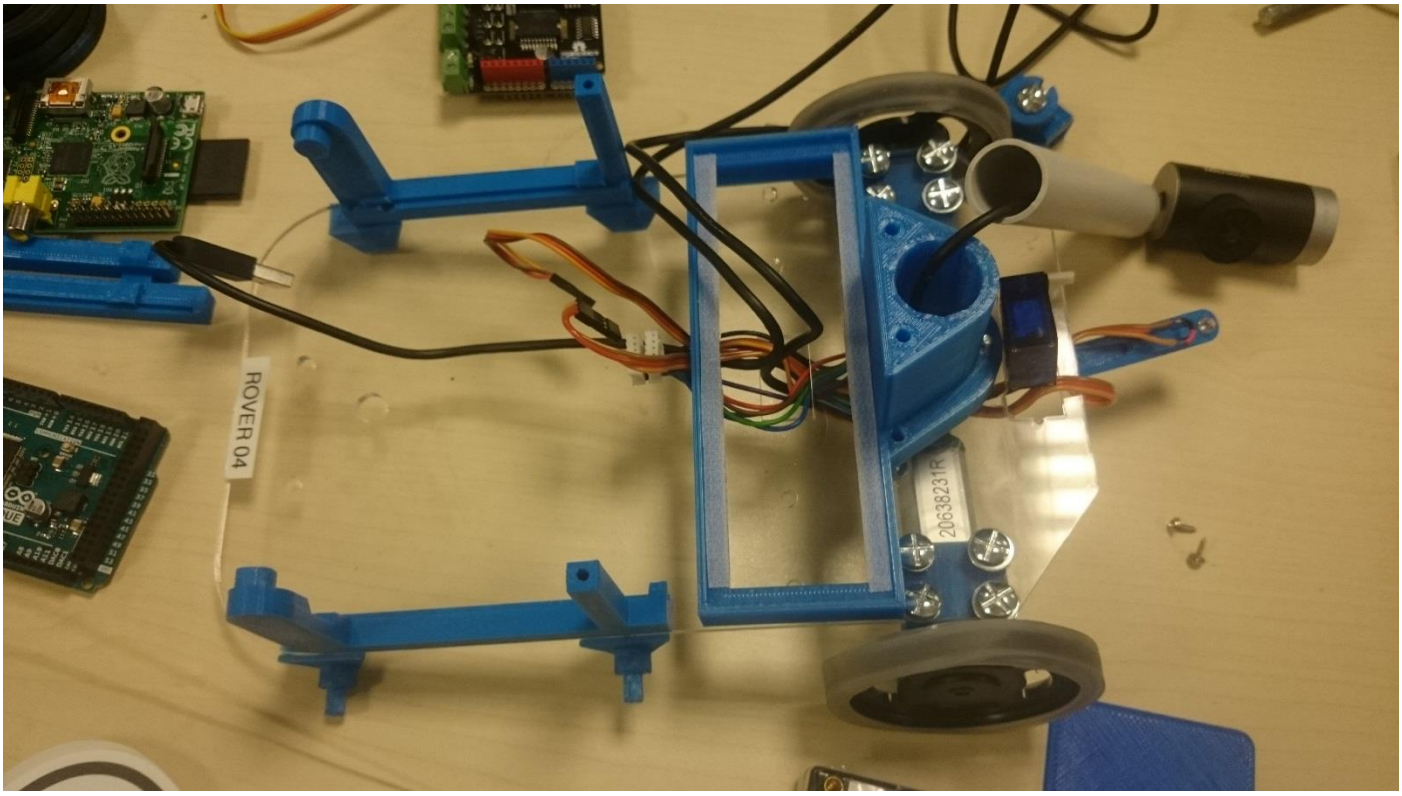
8. Now thread the servo wire through the acrylic plate holes



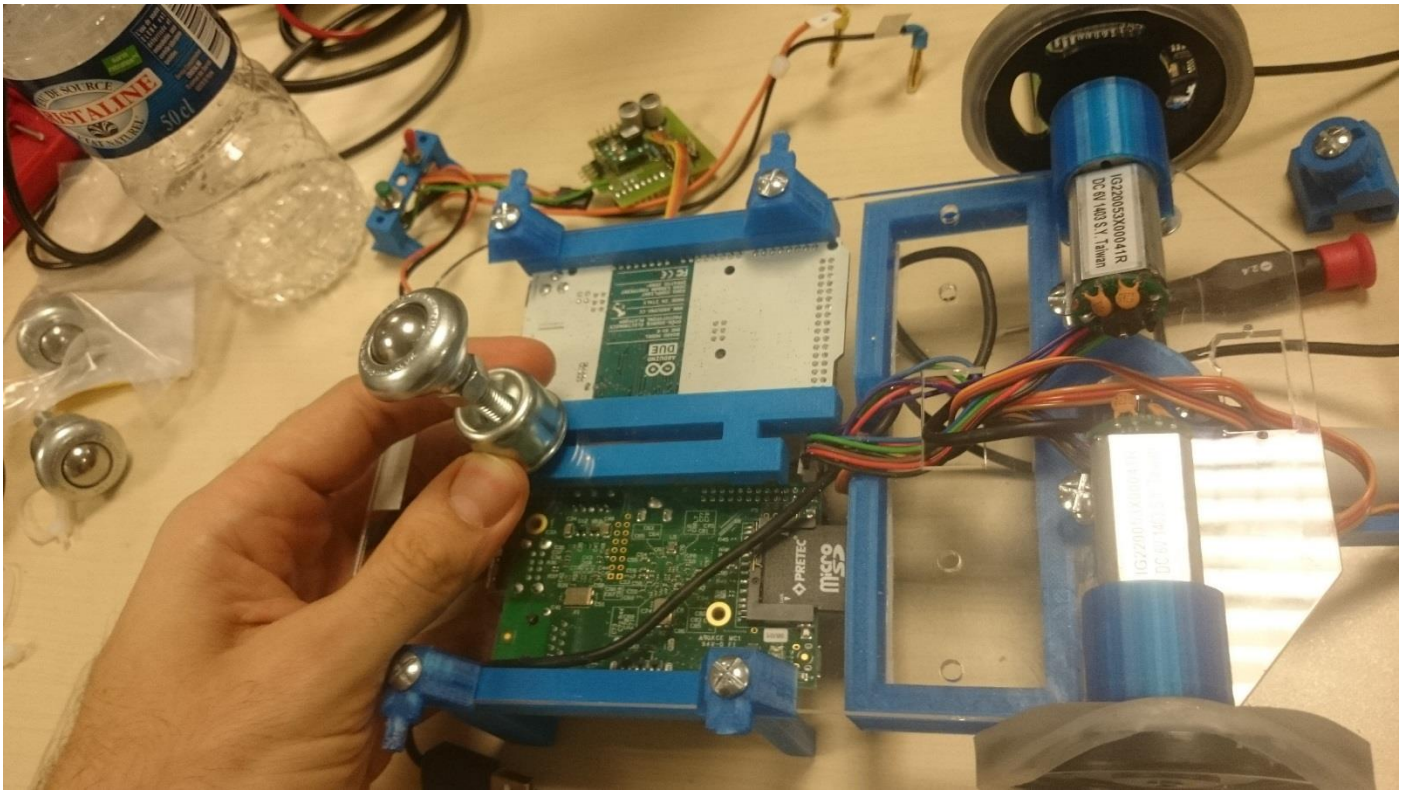
9. Now place the 3D printed camera mount base on the acrylic plate and thread the camera cable through the tube and the mount base and the acrylic plate



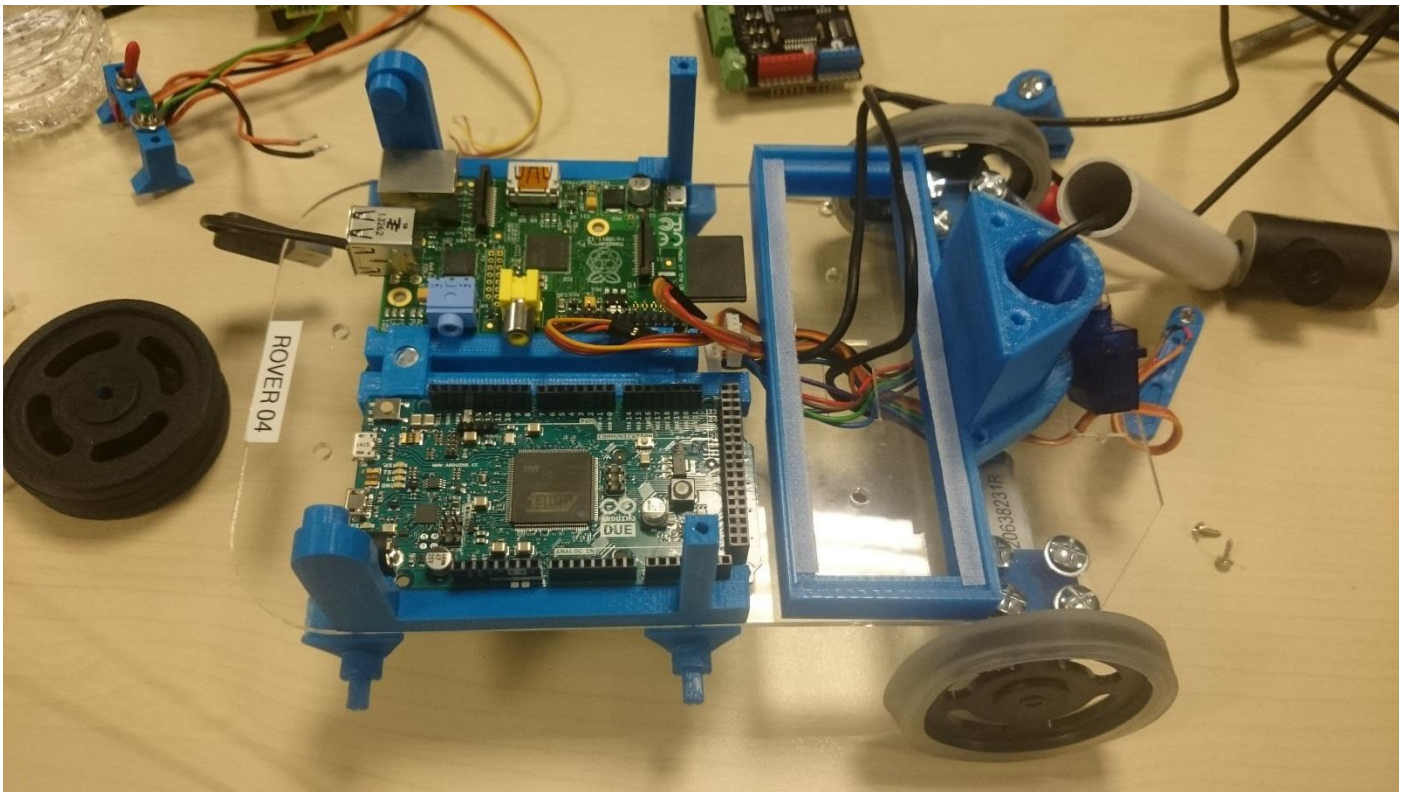
10. Thread all the wires through the camera base slot and pull the excess camera USB cable through so that it can be hidden under the battery. The USB cable will be wound up and zip tied in a later step.



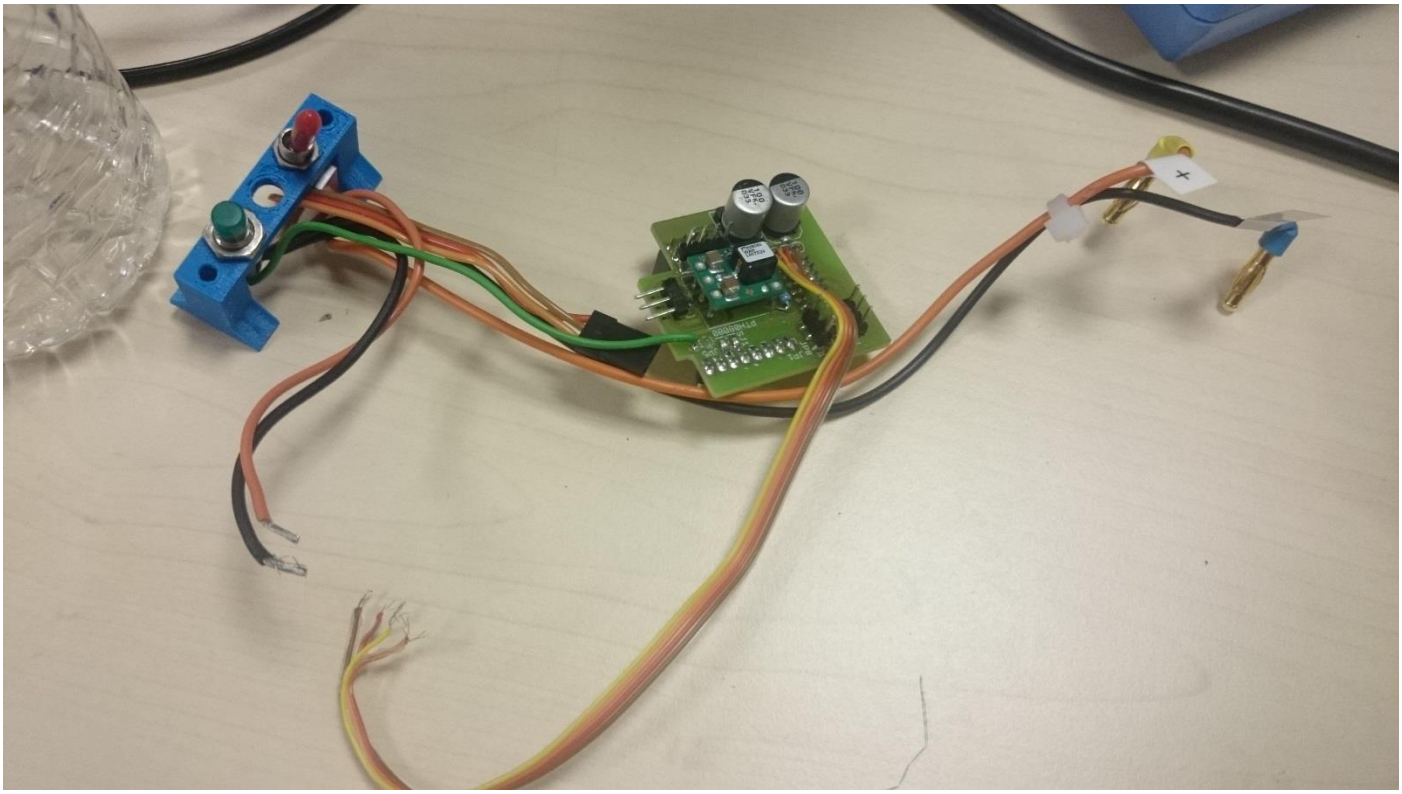
11. Review the picture for this step along with the picture for the next step. Insert the Arduino and Raspberry Pi boards in their respective positions using the center 3D printed piece to hold them in place and the threaded wheel shaft to secure everything in place.



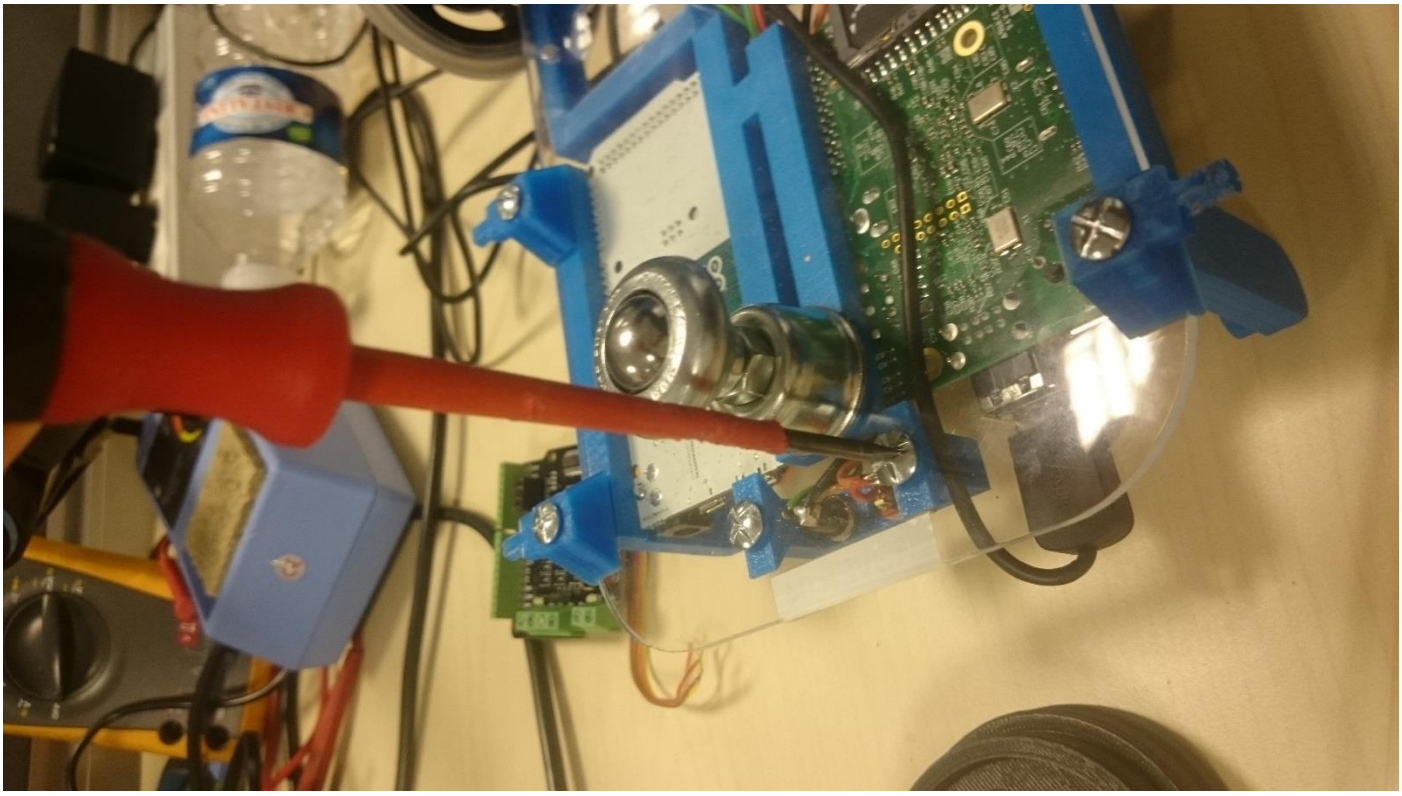
12. Once the cards secured in place, the robot should look like this.



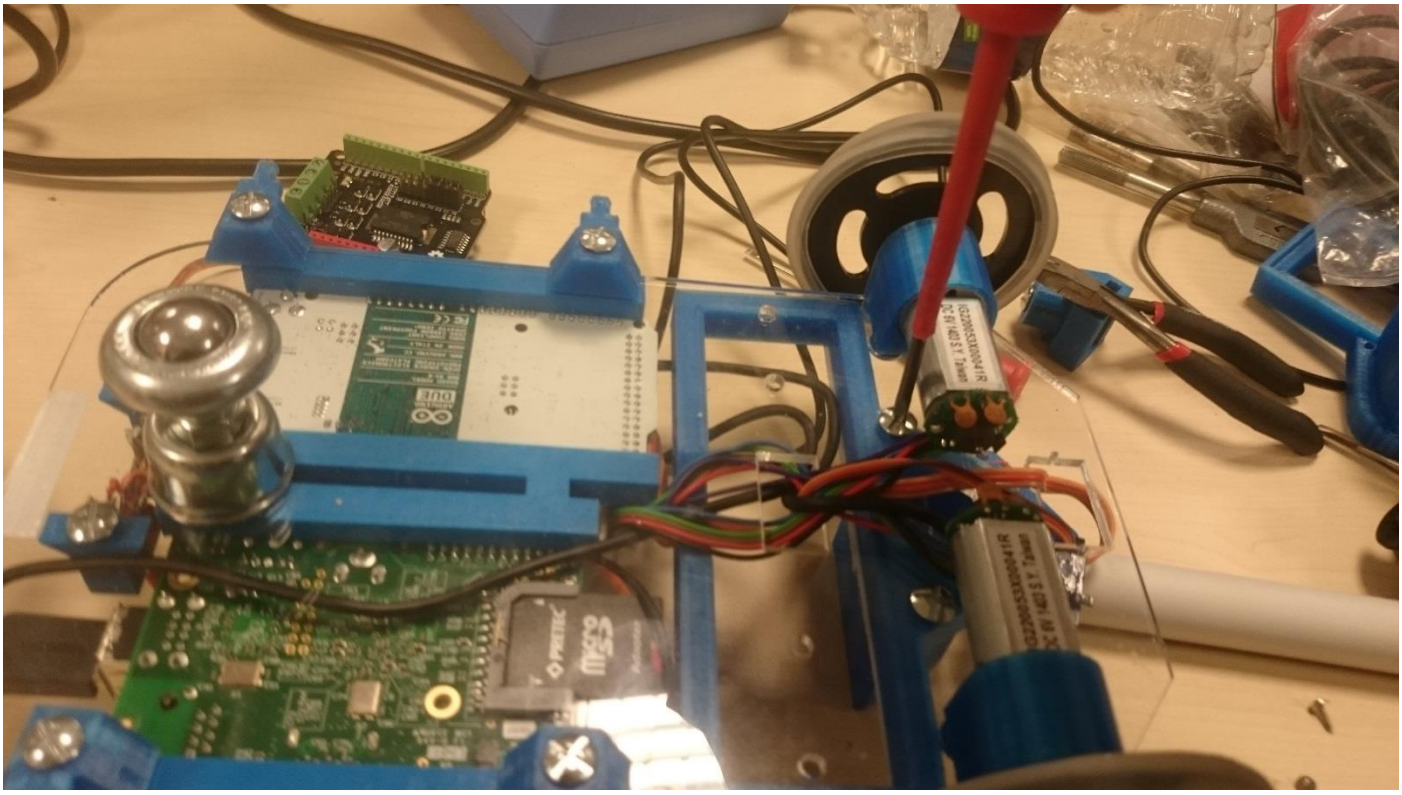
13. Assemble the circuit board and solder the wires to the switches as follows:



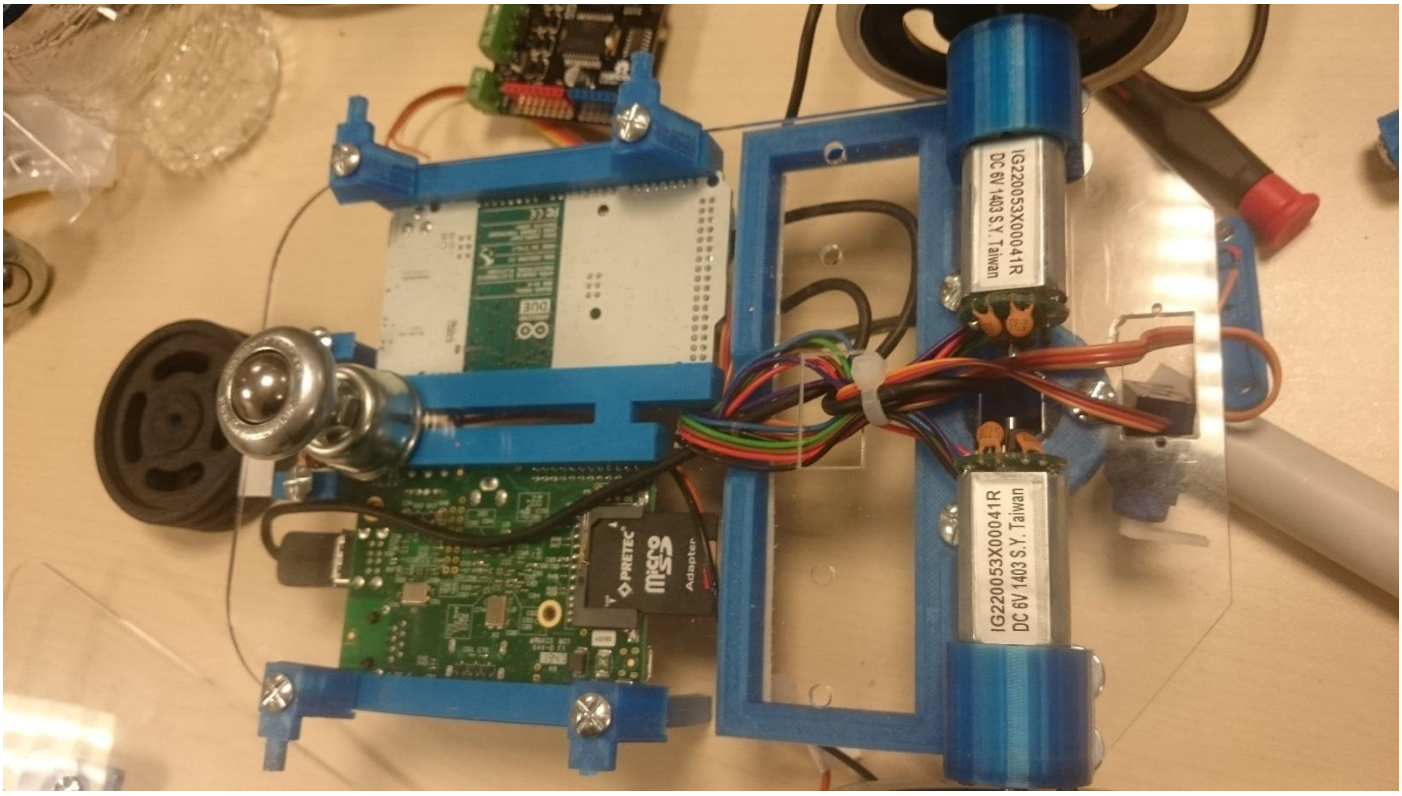
14. Screw the switch holder in place using two 20mm m4 screws



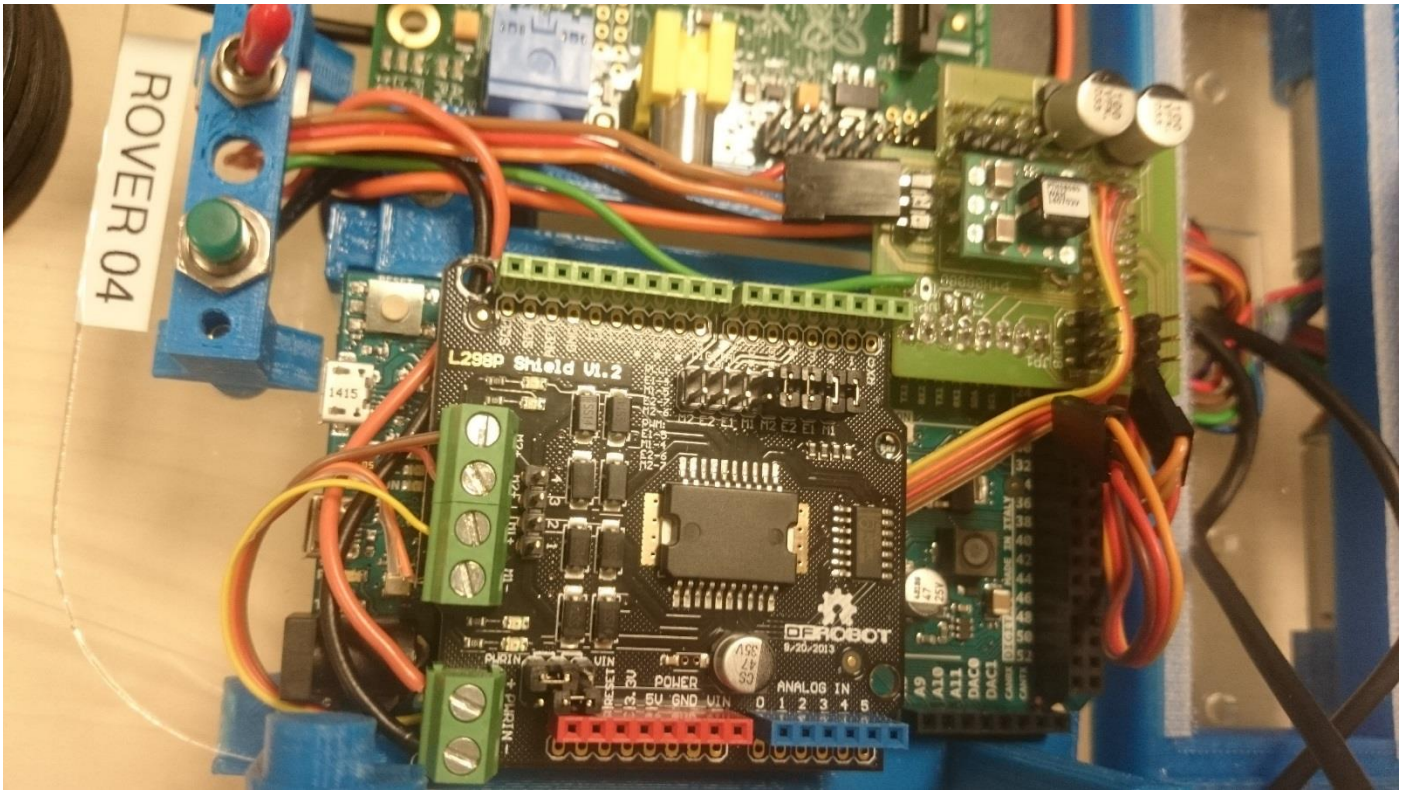
15. Screw the camera mount base into place being careful to route the cables nicely



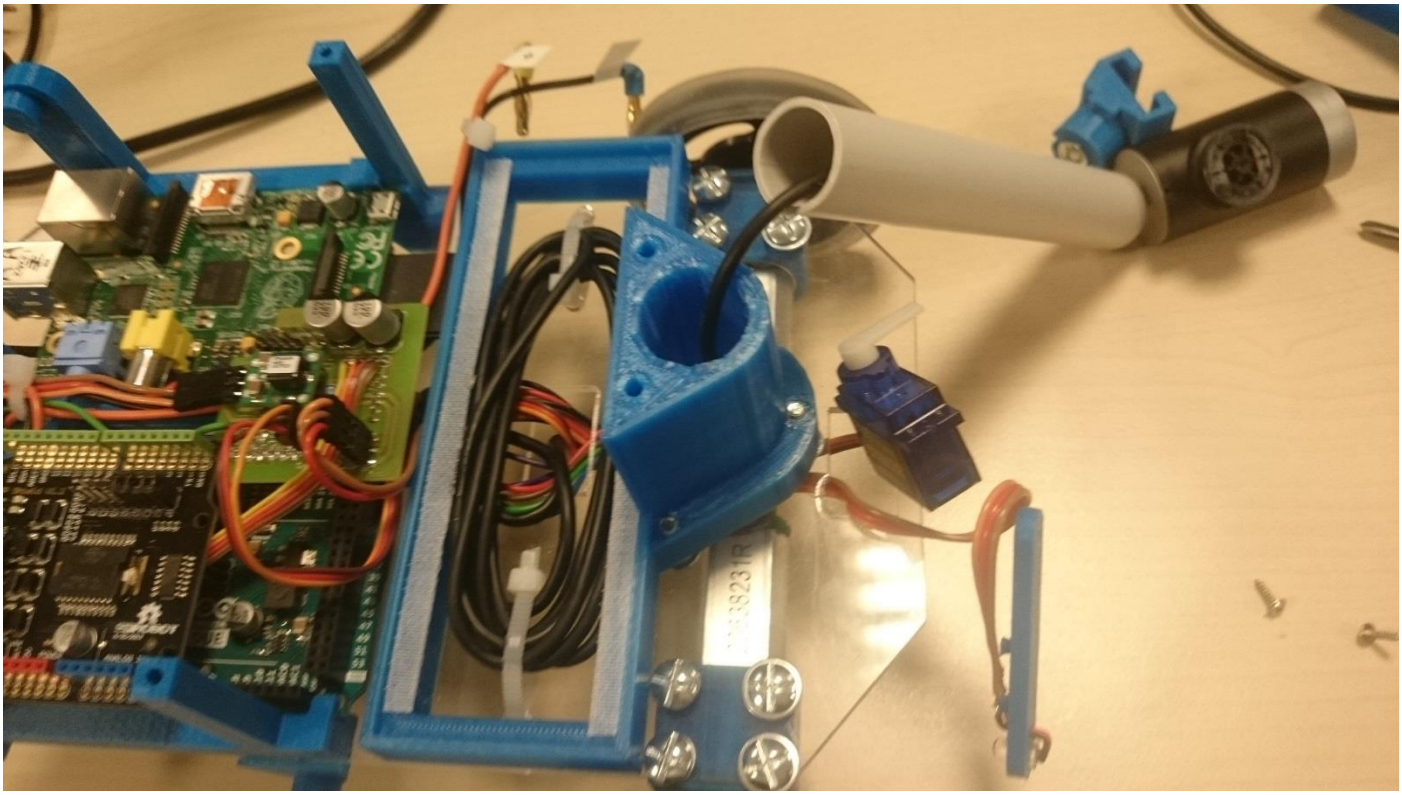
16. Add a zip tie to hold the cables in a clean bundle



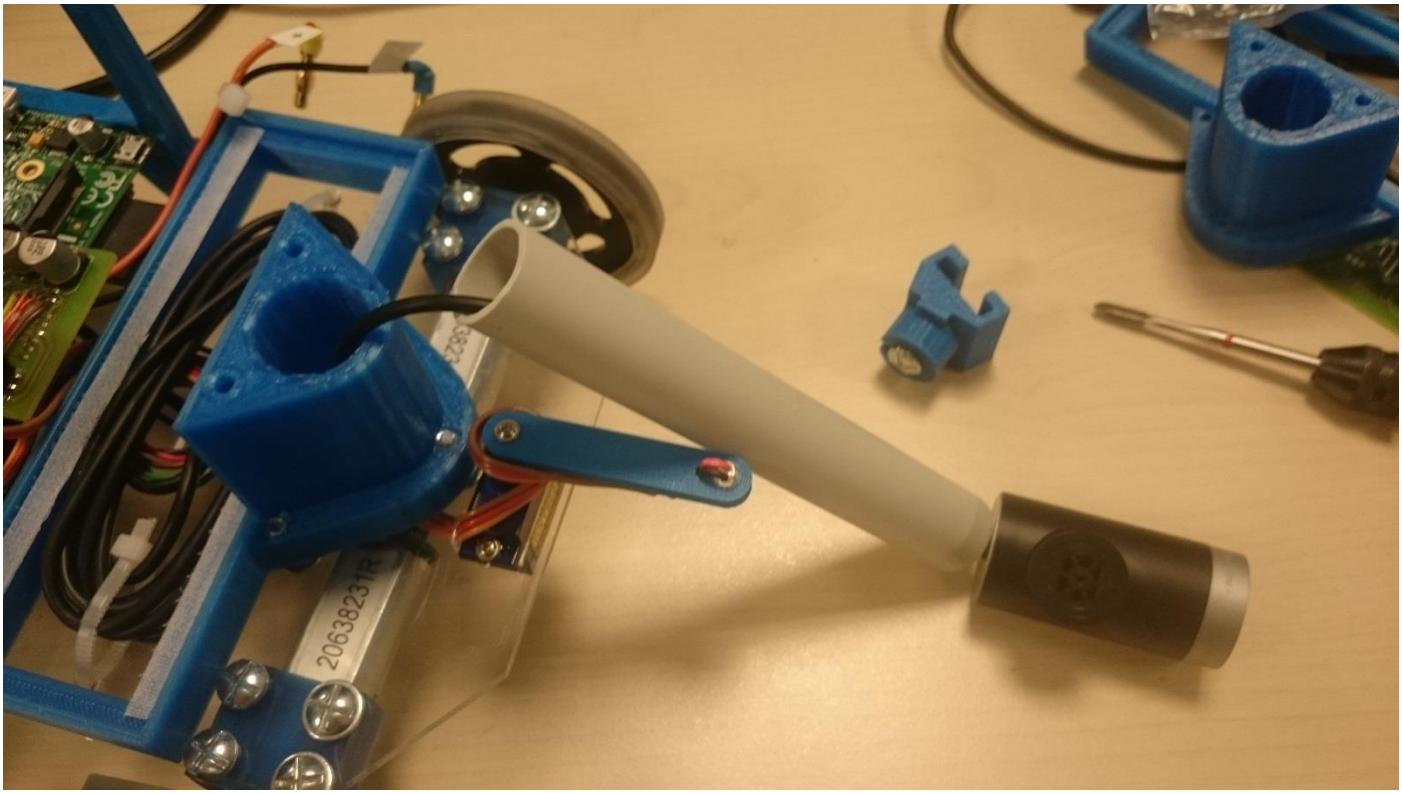
17. Place the motor shield on the Arduino and the power supply board on the Arduino and Raspberry Pi being careful that the headers go into the proper holes. The four motor wires soldered to the power supply board should screw into the motor shield in the order shown.



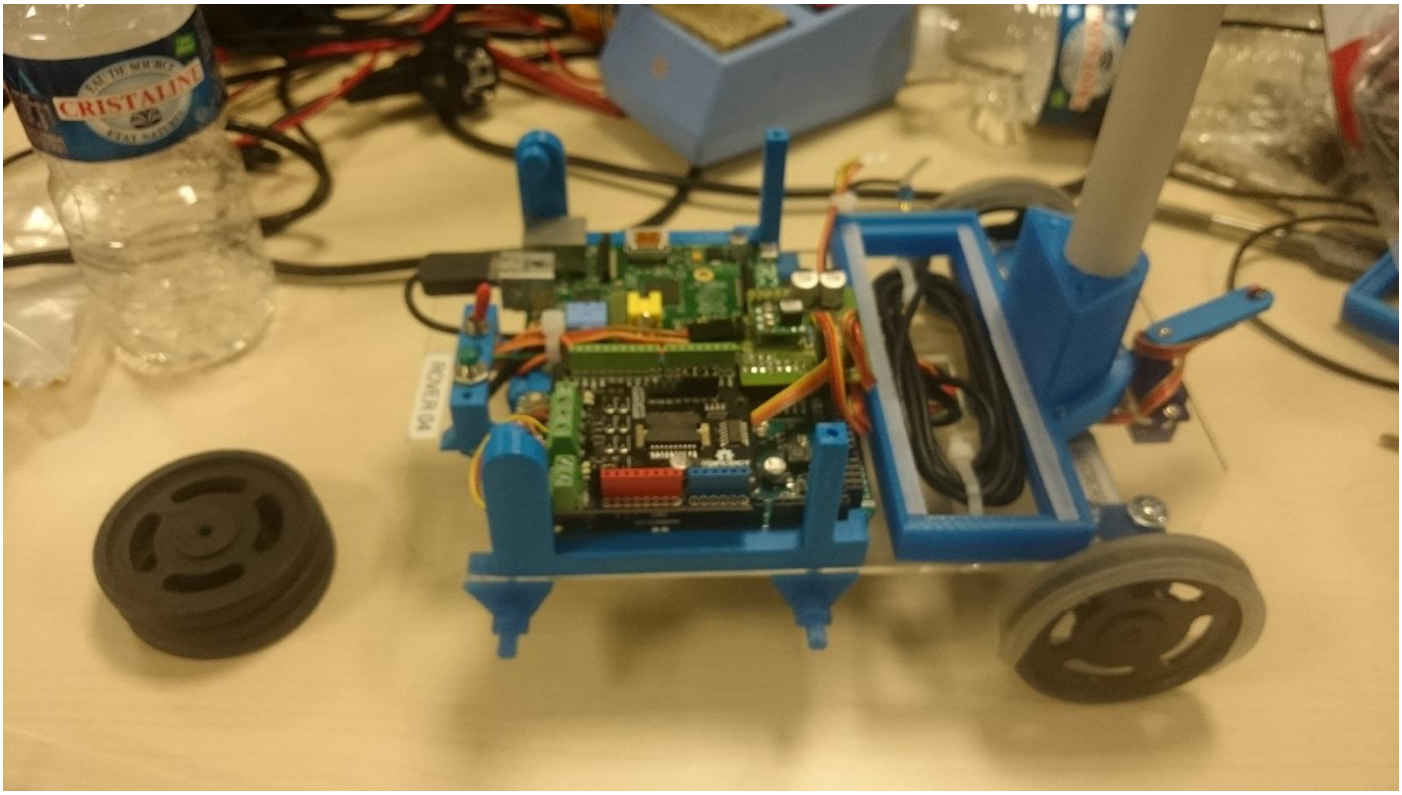
18. Zip tie the USB cable into place making sure it low enough that it will not interfere with the battery once it is placed on the base. Add the battery Velcro (white strips below):



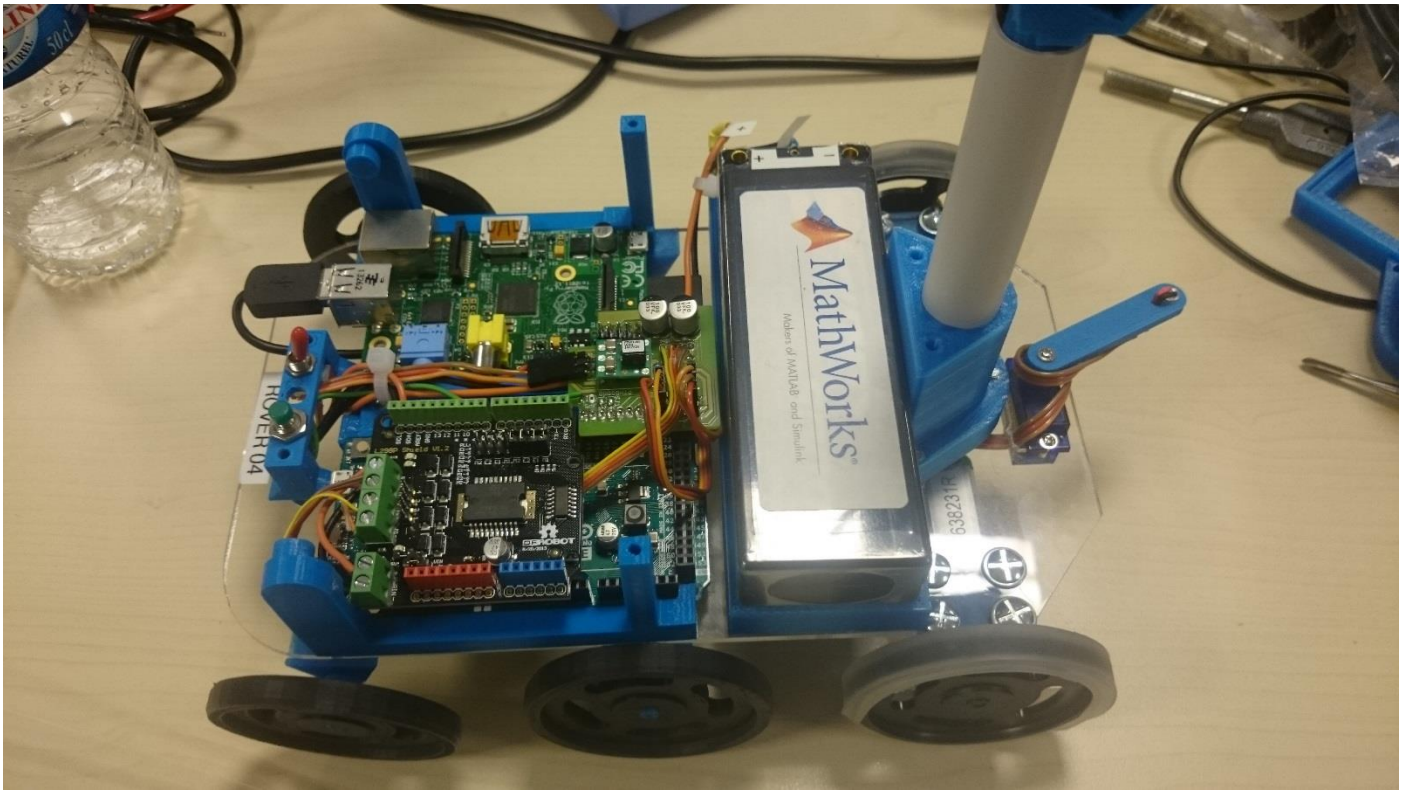
19. Screw together the two camera mount pieces together and use it to mount the camera onto the tube. Screw the servo into place as well as the servo arm.



20. Push the camera tube into place Asdf



21. Add the fake wheels if you have them, don’t worry about it if you don’t. Put the battery in its place.



22. Close up of the wiring on underside of assembled robot: