

# Mirto 2023 Build Information

This document describes the CS (Raspberry Pi/Teensy) and Arduino variants of the Mirto robot.  
Either robot can be built with or without bump or IR sensors.

Document Version 0.1 (draft)  
Last updated April 30 2023 by Michael Margolis

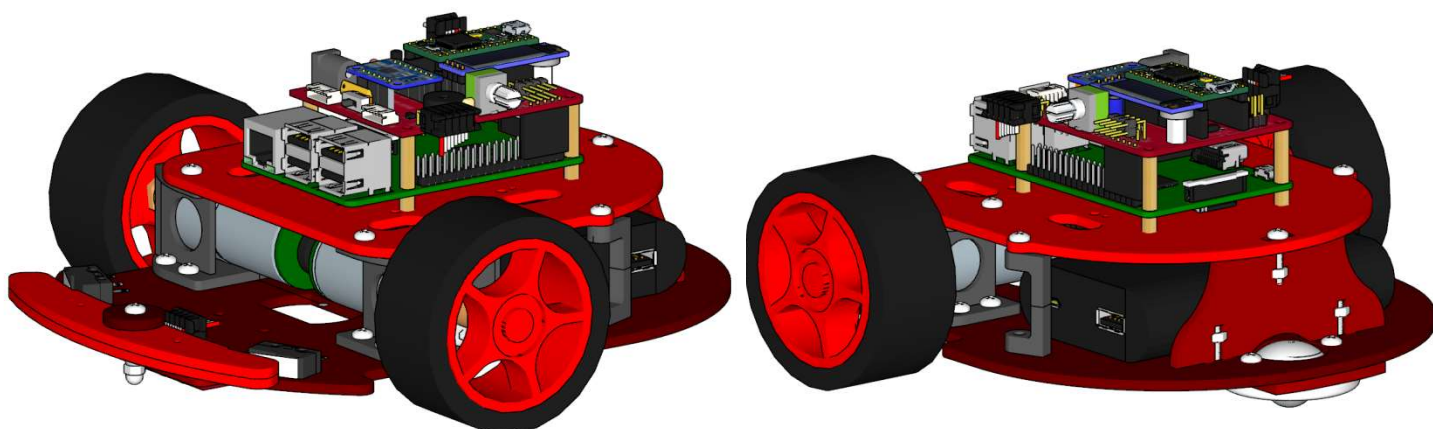


Figure 1: CS Mirto with bump and IR sensors

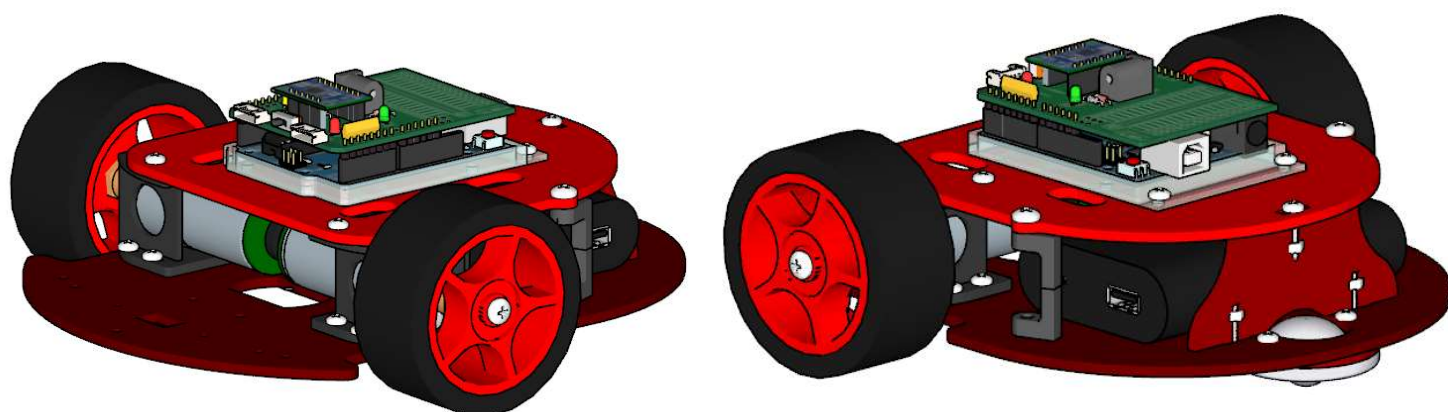


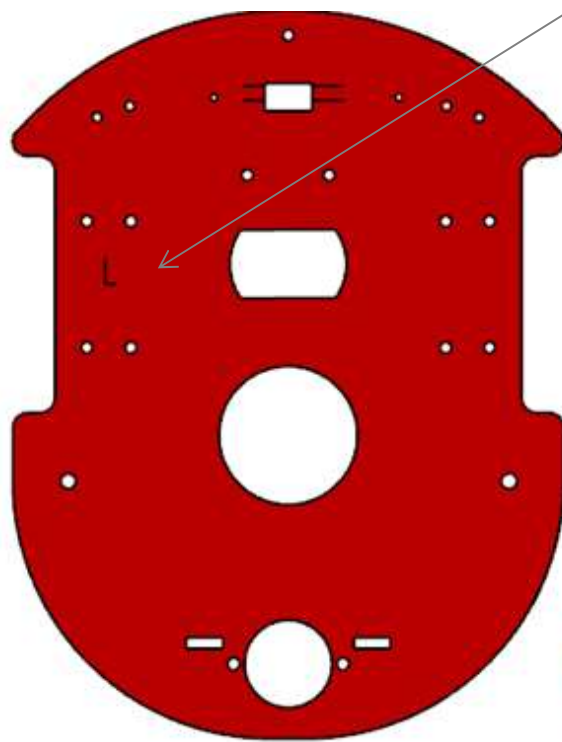
Figure 2: Arduino WiFi R2

Robot Components (see Electronic Assembly Section for wiring and electrical parts not shown).

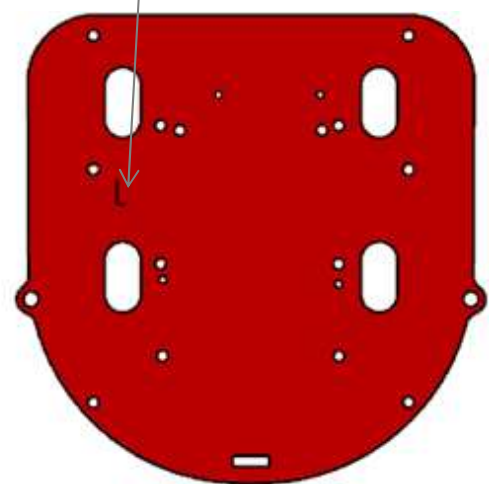
Supplier part numbers for hardware and electronic components can be found at:  
[https://github.com/michaelmargolis/Mirto2023/tree/main/docs/Mirto\\_BOM.xlsx](https://github.com/michaelmargolis/Mirto2023/tree/main/docs/Mirto_BOM.xlsx)

Note orientation of top and bottom plates, left side indicated by letter L

Figures are not to scale



Bottom Plate



Upper Plate



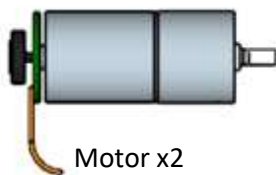
Caster Spacer



Rear bracket



Offset Spacer



Motor x2



Hub x2



Motor Mount x2



Caster



Wheel x2



Bumper x2



Bumper Cap



IR Sensors Spacer x2









IR Sensor Board





Switch X2

**These parts are only required for robots with Bump and IR Sensors**




Hardware for core robot:

Quantity	Description	
4	M3 x 5 socket button screw	
2	M3 Grub screw	
12	M3 X 10 pan head machine screw	
5	M3 X 12 pan head machine screw	
19	M3 nut	
4	M4 X 8 pan head machine screw	








**Arduino Robot controller mounting hardware (For Arduino Uno Wifi and PCB)**

Quantity	Description	
4	M 3 x 8 pan head machine screw	
4	M 3 nut	



**CS Robot mounting hardware (for Raspberry Pi and Mirto PCB)**

Quantity	Description	
8	M2.5 x 12 pan head machine screw	
4	M2.5 x 4 threaded standoff for Pi	
4	M2.5 x 16 threaded standoff for Mirto PCB	

#### Additional hardware for robot with bump sensors

Quantity	Description	
1	M3 X 20 socket button screw	
1	Plastic washer	
1	M3 X 6 spacer	
1	M3 locknut	
1	Nylon dome nut	
4	M2.5 x 12 pan head machine screw	
4	M2.5 nut	

#### Additional Hardware for robots with IR Sensors

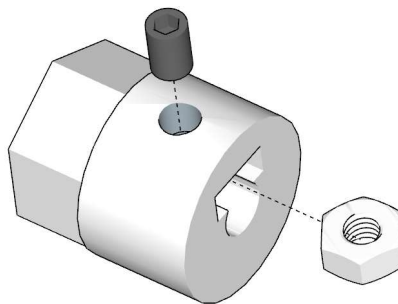
Quantity	Description	
2	M2 X 12 pan head machine screw	
2	M2 nut	

Build notes:

- **Read through all steps before beginning assembly**
- Double check hardware before each assembly step and make sure that the length of the screw matches the instructions.
- Look at the prototype if you are not sure how things go together
- **Don't overtighten the screws**
- Machine screws are pan head where not specified.
- Use thread lock only after initial assembly

If not already fitted, insert M3 nut into slot on hub and hold in place with grub screw

Figure 3A: Hub Detail



Attach motors to mount using M3x5 button head screws. Don't overtighten these screws.  
Note left and right motor positions are mirror images.

**Caution – you must use the M3x5 hardware specified, longer screws will damage the gearbox!**

Hardware: 2 off M3 x 5 socket button screws for each motor  
2 off M3 grub screws and M3 nuts for hubs

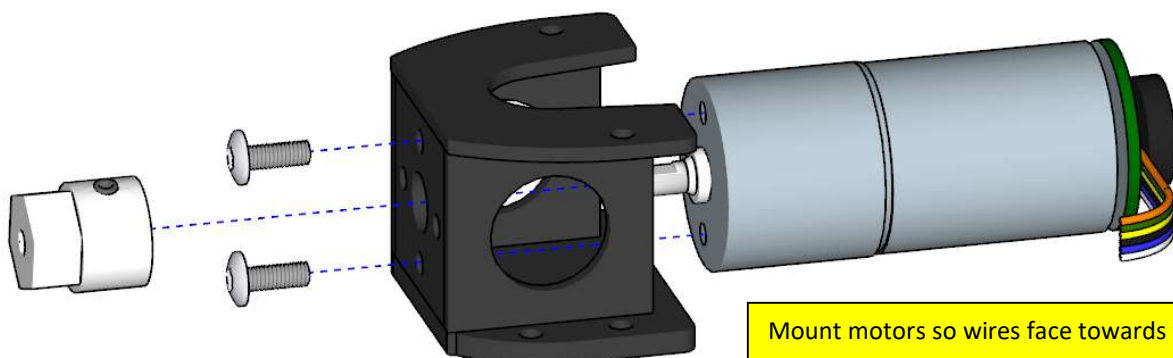


Figure 3B: Motor Mount

Attach hub. There should be a slight gap to avoid touching motor screws

The motor brackets are attached to the bottom plate with the motor wires facing to rear of the robot. **Important: Orient base plate so letter L is on the left side of robot as shown in the figure**

Hardware:

8 off M3 x 10 pan head machine screws and nuts

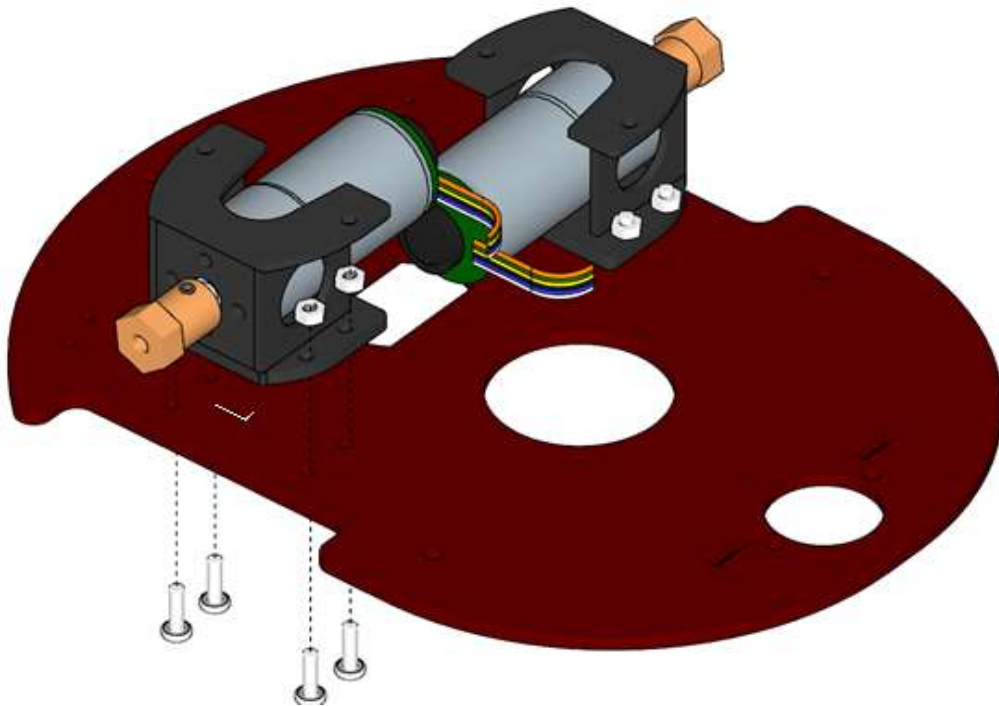
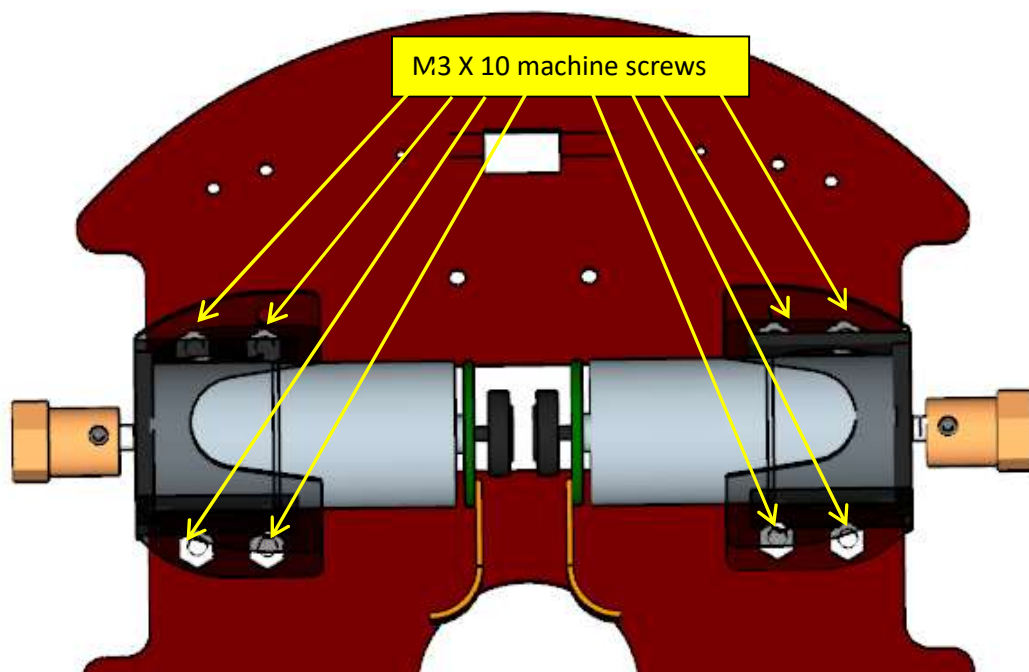


Figure 4: Mounting motors

important: Ensure motors are mounted so both motor wires extend to rear of robot



Attach the Standoffs, rear bracket and caster.



Hardware:

4 off M3 x 12 pan head machine screws and nuts

2 off M4 x 8 pan head machine screws

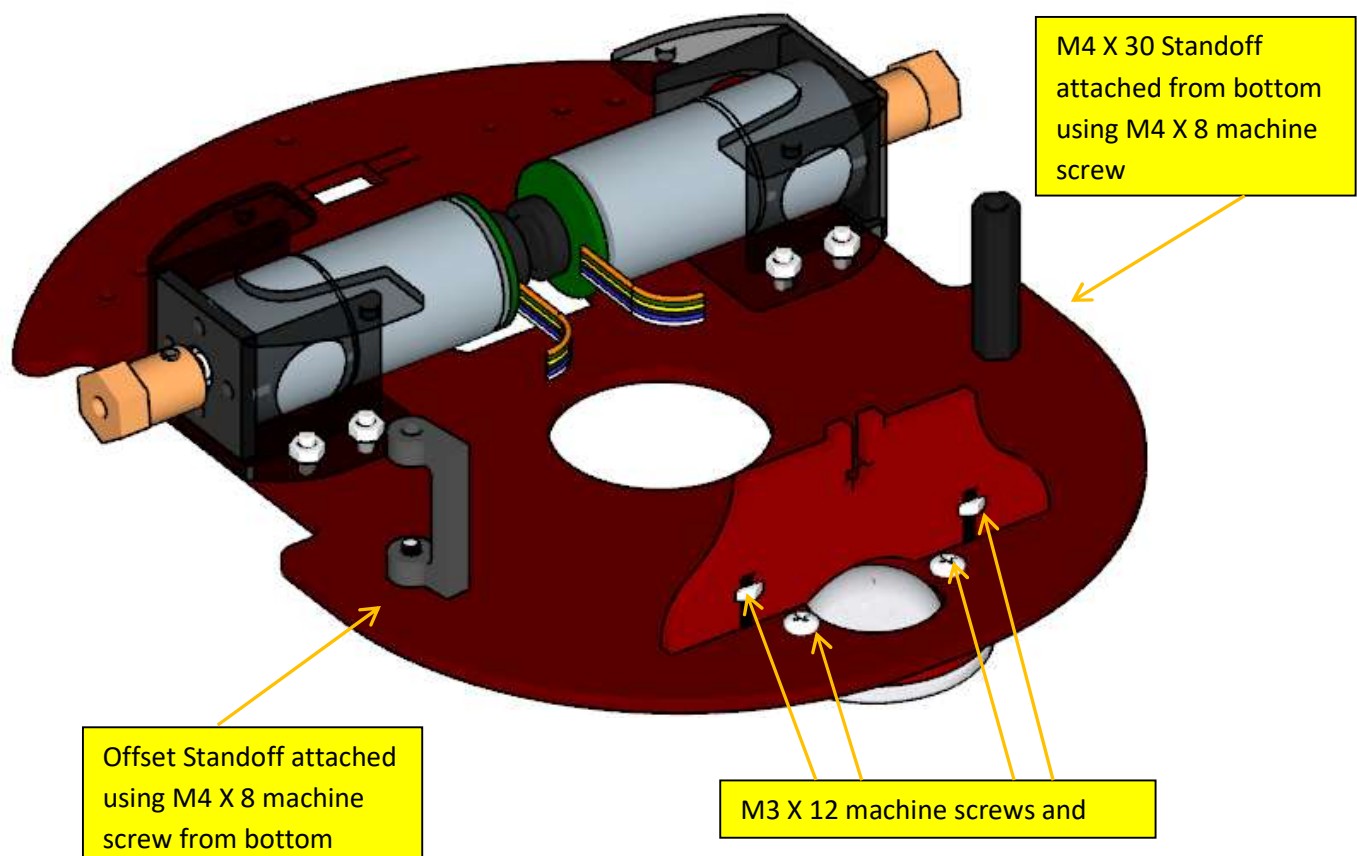


Figure 5A: Component Location on bottom frame

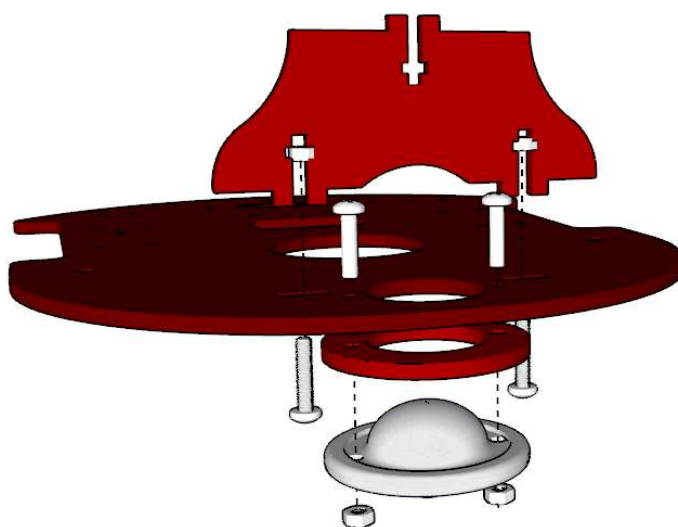


Figure 5B: Bottom frame detail - Note the location of the caster spacer

Skip this  
robot without bump switches or IR Sensors.

page if building the

Attach two bumpers to the lower plate using a 20mm M3 button head screw. The washer and spacer are used to enable the bumpers to be held firmly but slide easily. Variations in acrylic thickness may require a second washer or no washer at all. The lock nut is metal with a nylon insert that resists turning; you will need to hold this nut with pliers when tightening the screw with a hex key. The plastic dome nut is then screwed onto the bottom to act as a skid to prevent the robot tipping forward and damaging the IR sensors

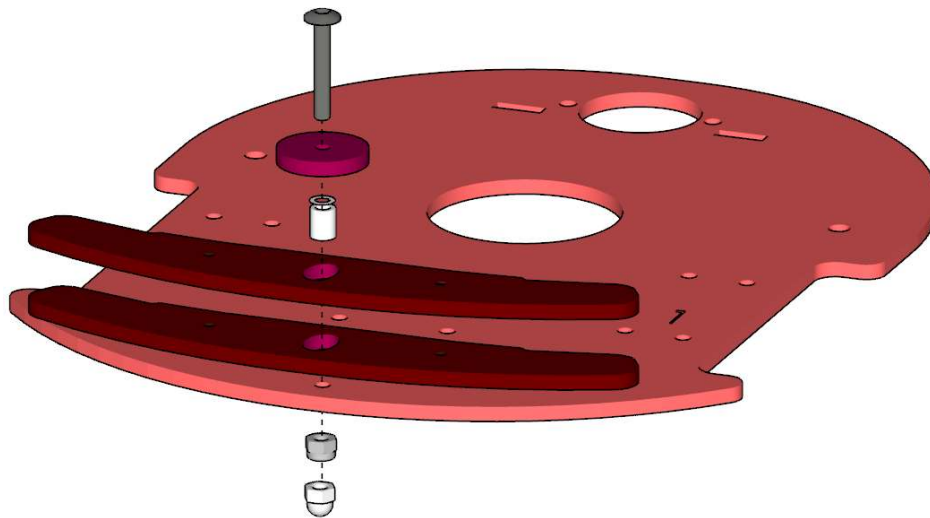


Figure 6A: Location of Bumper mounting hardware

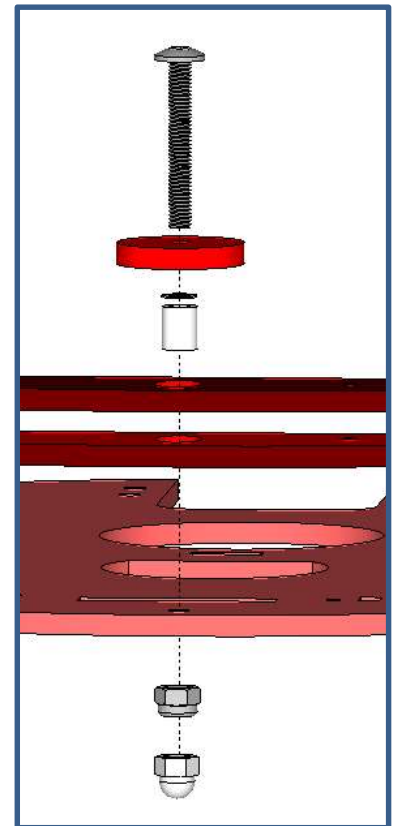


Figure 6B: Bumper Assembly Detail

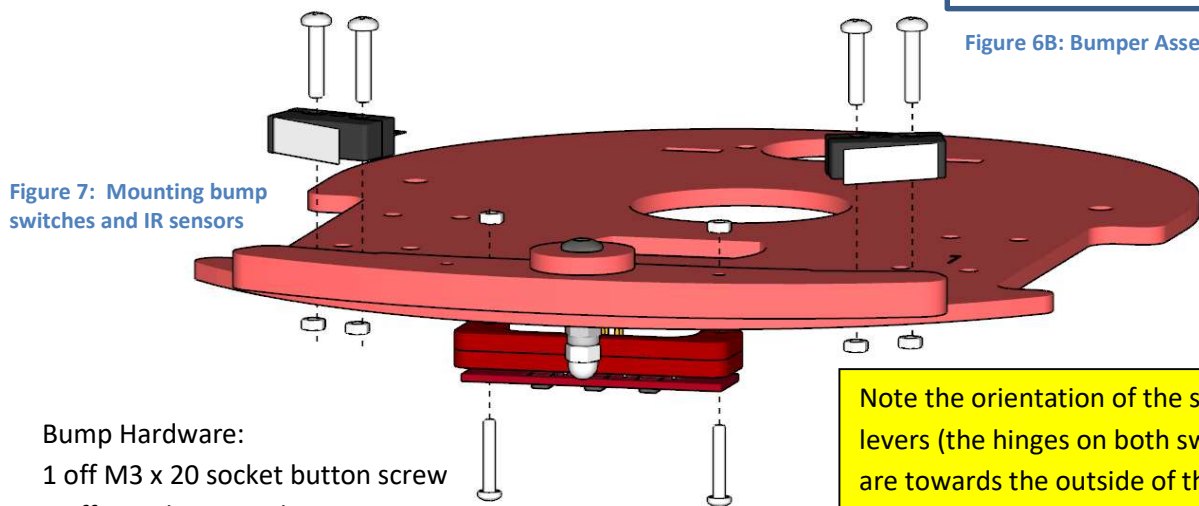


Figure 7: Mounting bump switches and IR sensors

Note the orientation of the switch levers (the hinges on both switches are towards the outside of the plate)

#### Bump Hardware:

- 1 off M3 x 20 socket button screw
- 1 off M3 plastic washer
- 1 off M3 6mm spacer
- 1 off M3 lock nut
- 1 off M3 plastic dome nut
- 4 off M2.5 x 12 pan head screws
- 4 off M2.5 nuts

#### IR sensor Hardware:

- 4 off M2x12 pan head screws
- 4 off M2 nuts

Assembling the Raspberry PI version (see next page for Arduino version)



Attach four M2.5X4 spacers using M2.5X12 machine screws. Note the location of the holes as shown in figure

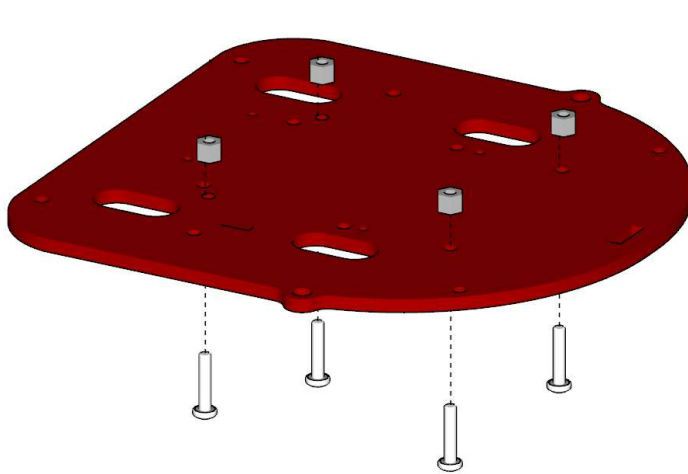


Figure 8A: Mounting standoffs for the Raspberry Pi

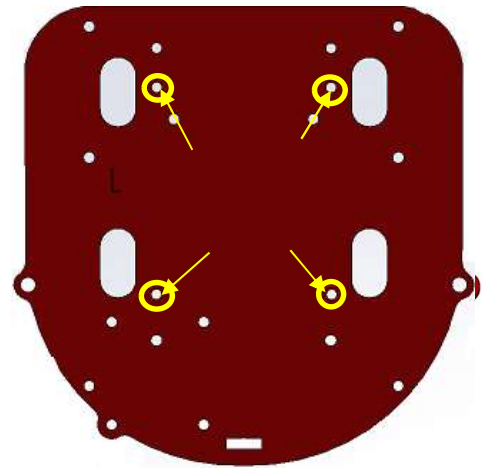


Figure 8B: Location of Raspberry Pi mounting holes

The Raspberry pi is inserted onto the screws and held in place using four M2.5X16 threaded standoffs. The Mirto2020 PCB is plugged into the Pi and secured using four M2.5X12 machine screws.

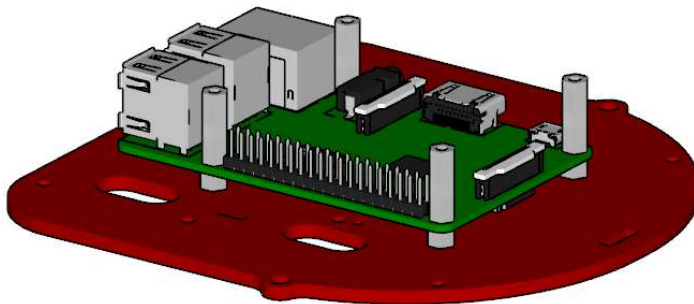


Figure 8C: Raspberry Pi positioned on standoffs

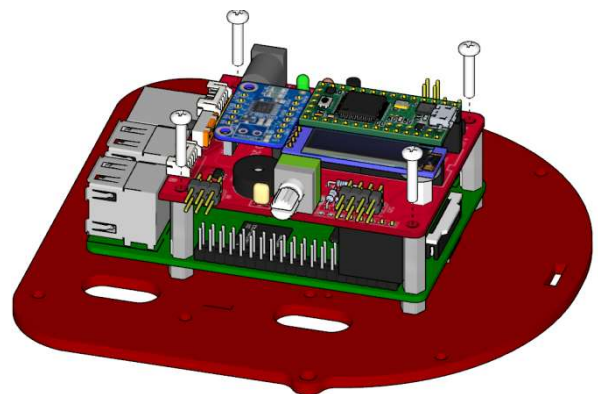


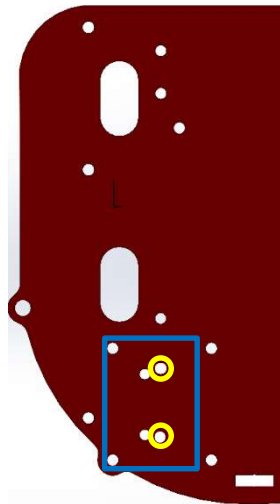
Figure 8D: Mirto circuit board on top of Pi

Hardware:

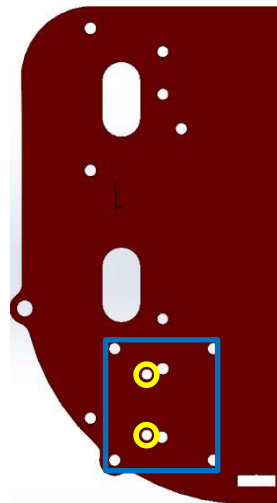
- 4 M2.5 x 4 standoffs
- 4 M2.5 x 16 standoffs
- 8 M2.5 x 12 machine screws

Boards that do not have build-in LCD display are attached to the top plate using the hole positions shown below:

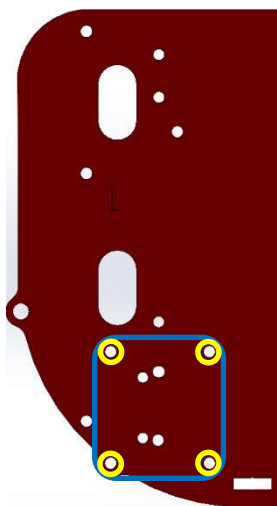
Teensy .96 OLED LCD mounting position.



Teensy 1.3 OLED LCD mounting position.



Pico board color LCD mounting position.



Assembling the Arduino version:

Attach the Arduino mount using four M3x8 machine screws and nuts. The mount is supplied with Arduino Uno WiFi rev 2 or can be ordered from Arduino supplier as part number X000019. The Arduino board and Mirto PCB can be press fitted to the mount after assembling the robot.

Hardware:

4 M3 x 8 machine screws

4 M3 nuts

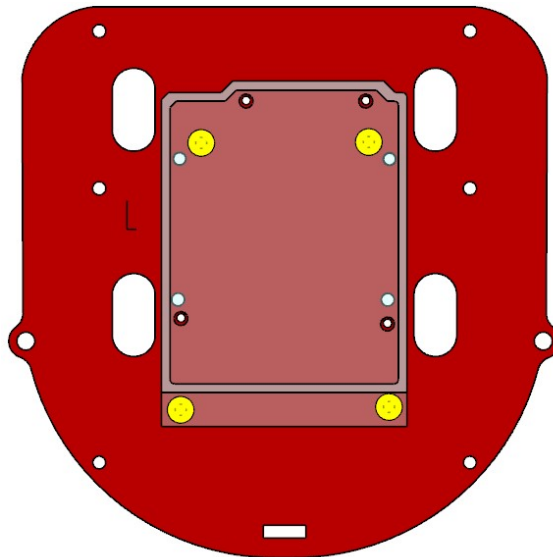


Figure 9A: Location of mounting holes for Arduino mount

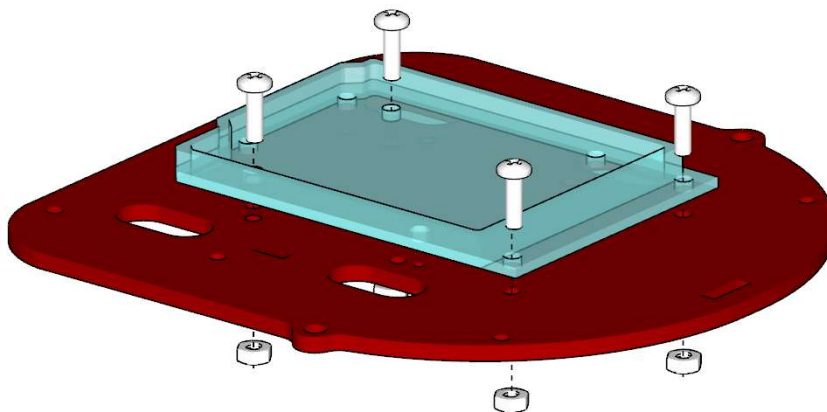


Figure 9B: Attaching Arduino mount

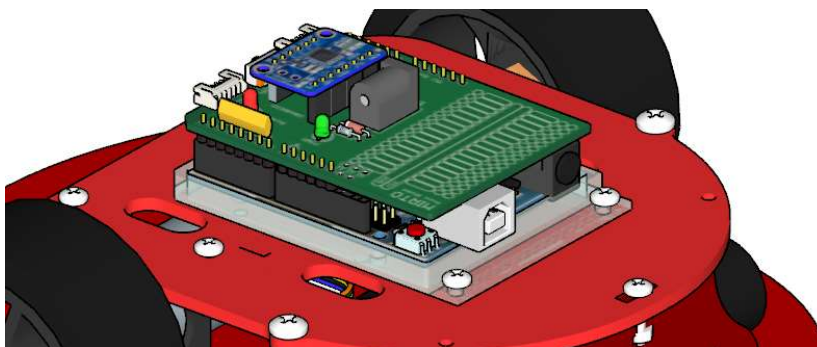


Figure 9C: Arduino and motor shield located on mount

Small pieces of Velcro can be used to hold the battery to the bottom plate to prevent sliding around when moved. Locate the battery on the bottom plate ensuring the charging and output connectors are accessible.

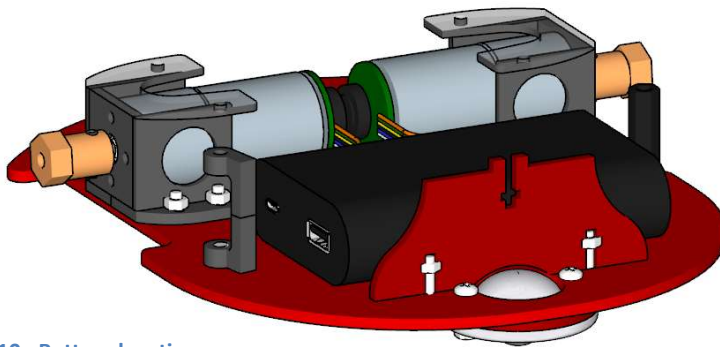


Figure 10: Battery location

Attach the top plate using four machine M3x10 screws and nuts into the motor mounts and two M4x8 screws into the rear standoffs.

Hardware:

- 4 M3 x 10 machine screws
- 1 off M3 x 12 machine screws
- 5 M3 nuts
- 2 M4 x 8 machine screws

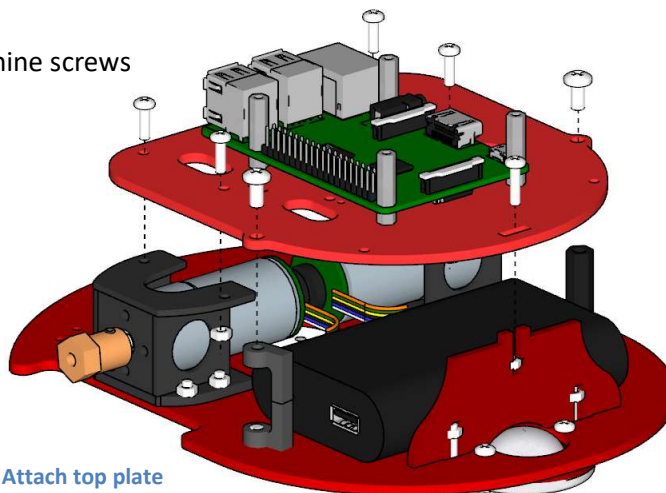


Figure 11: Attach top plate

Push the wheels onto the hubs and attach with M4X8 machine screws

Hardware:

- 2 M4 x 8 machine screws

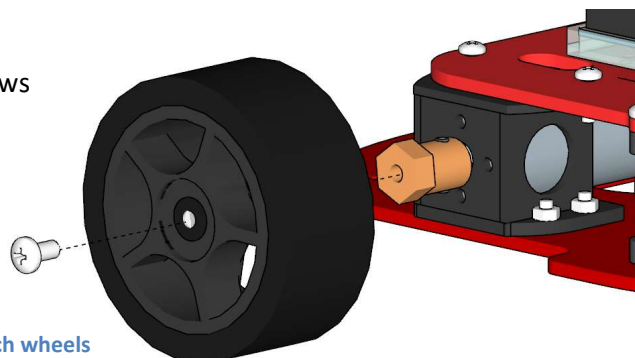


Figure 11: attach wheels

## Electronic Assembly and Wiring Information

The IR Sensor Connector Board is made by inserting three IR sensors from the underside of the board. Three 47K resistors and one 47 ohm resistor are placed on the upper side of the board. Solder two 0.1 uF ceramic capacitors and the 2x3 connector as shown below.

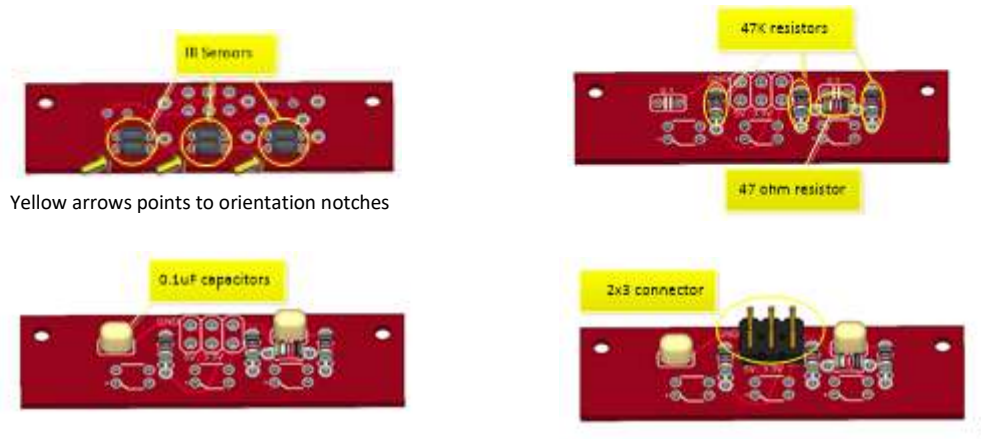


Figure 12: IR Sensor Connector Board

The IR sensors are connected to the main circuit board using a 6 conductor IDC cable.

The bump switch assembly is made by soldering 20 cm of four conductor ribbon cable to the switches as shown. The other end is crimped into a 2x2 IDC ribbon connector.

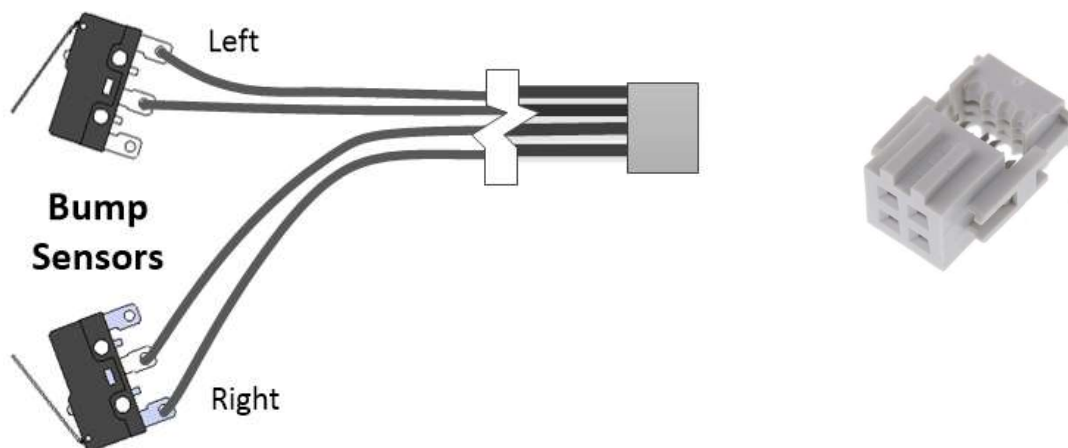


Figure13: Bump Switch Wiring

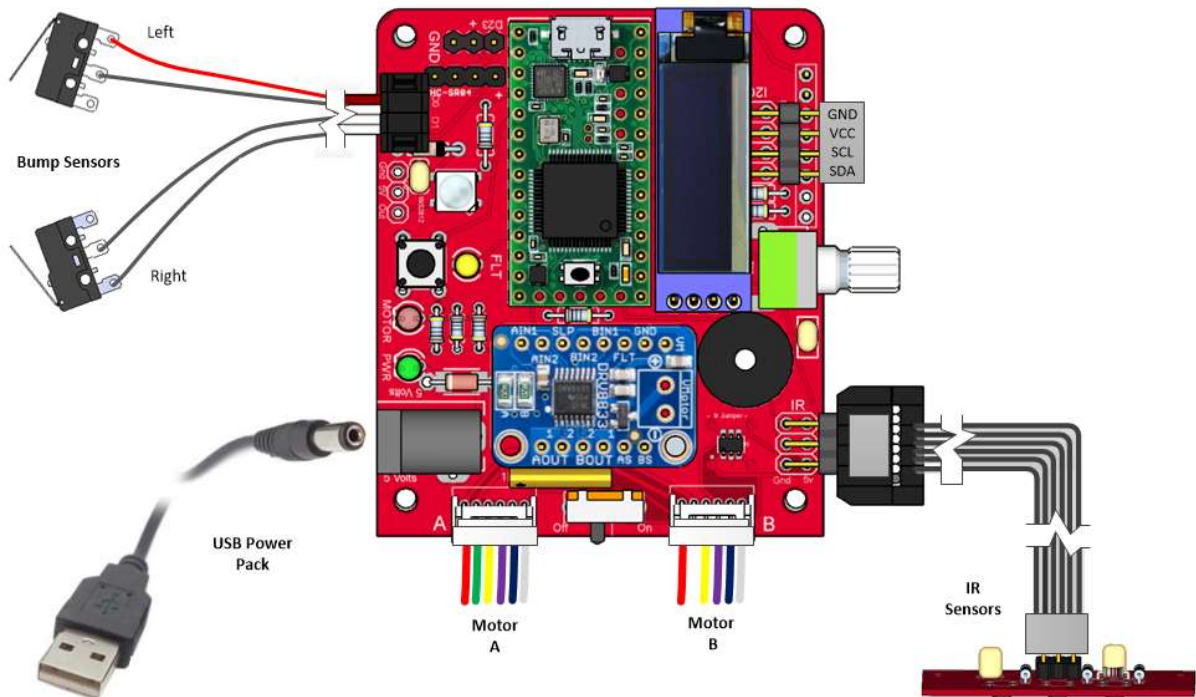


Figure 14: Wiring the Mirto 2020 board for Raspberry Pi

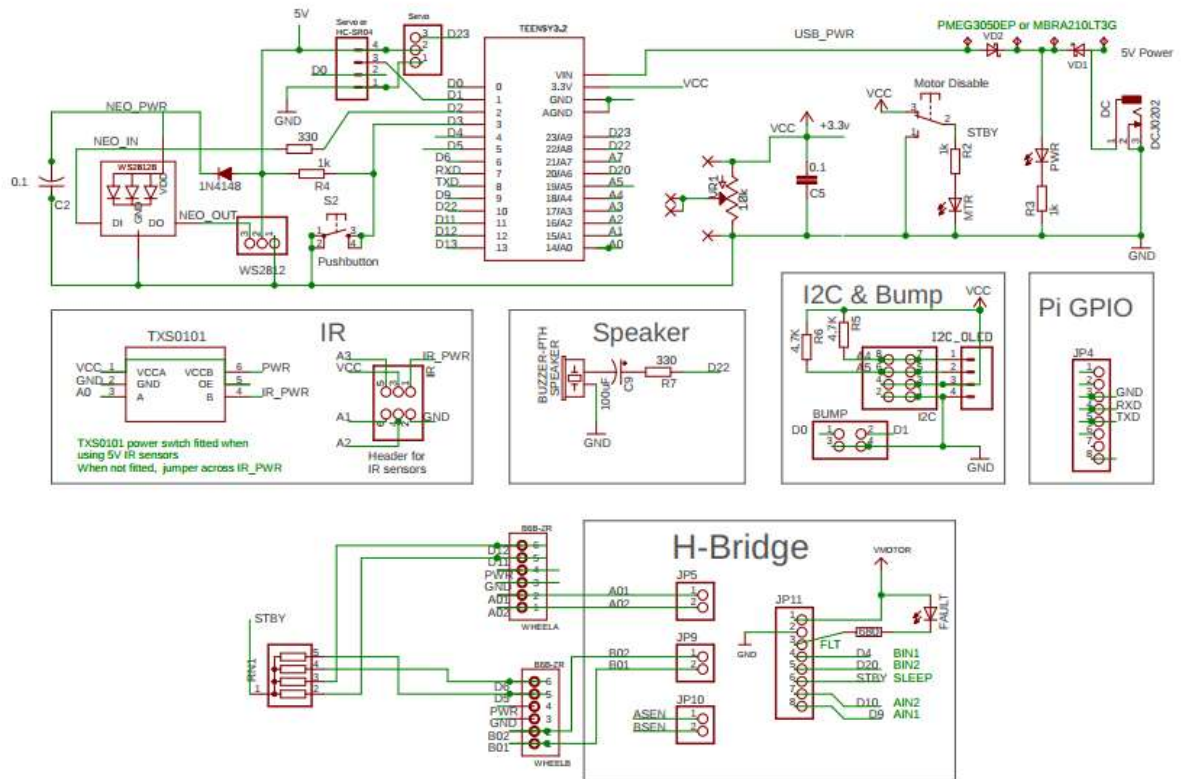


Figure 15: Schematic Diagram



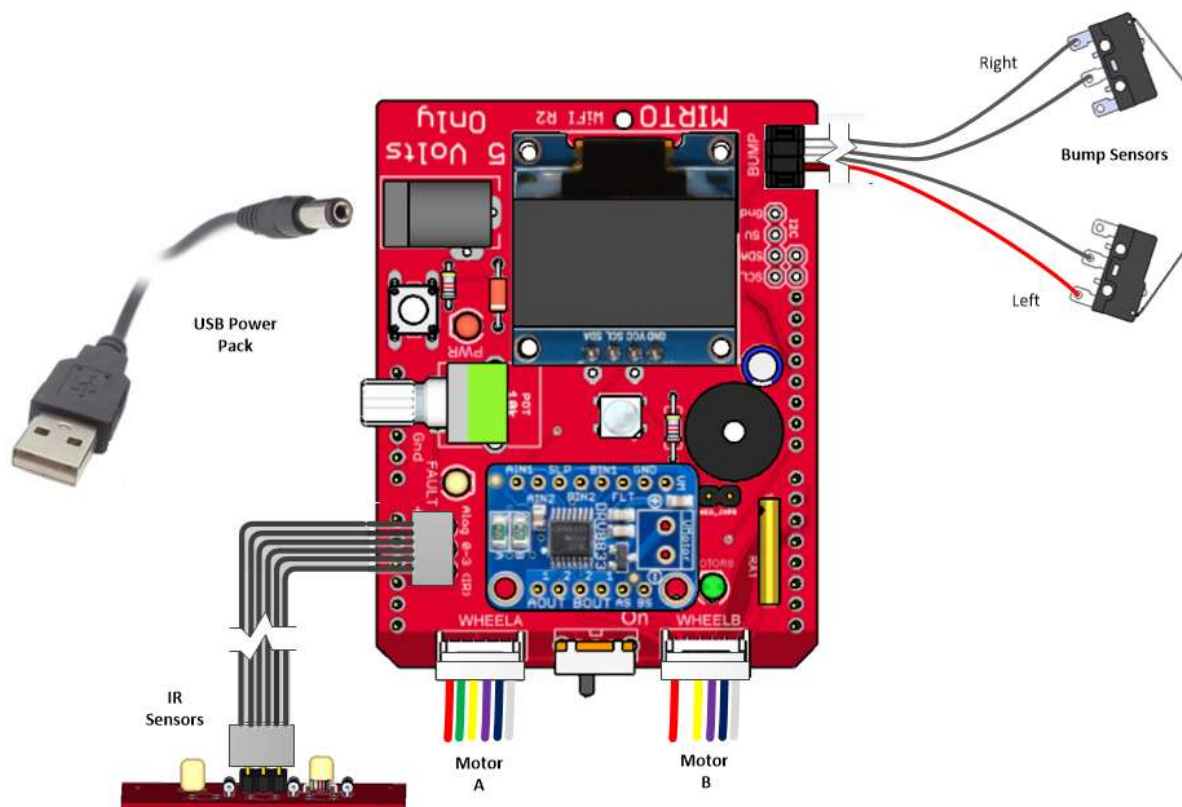


Figure 16: Wiring the Mirto Wifi R2 board

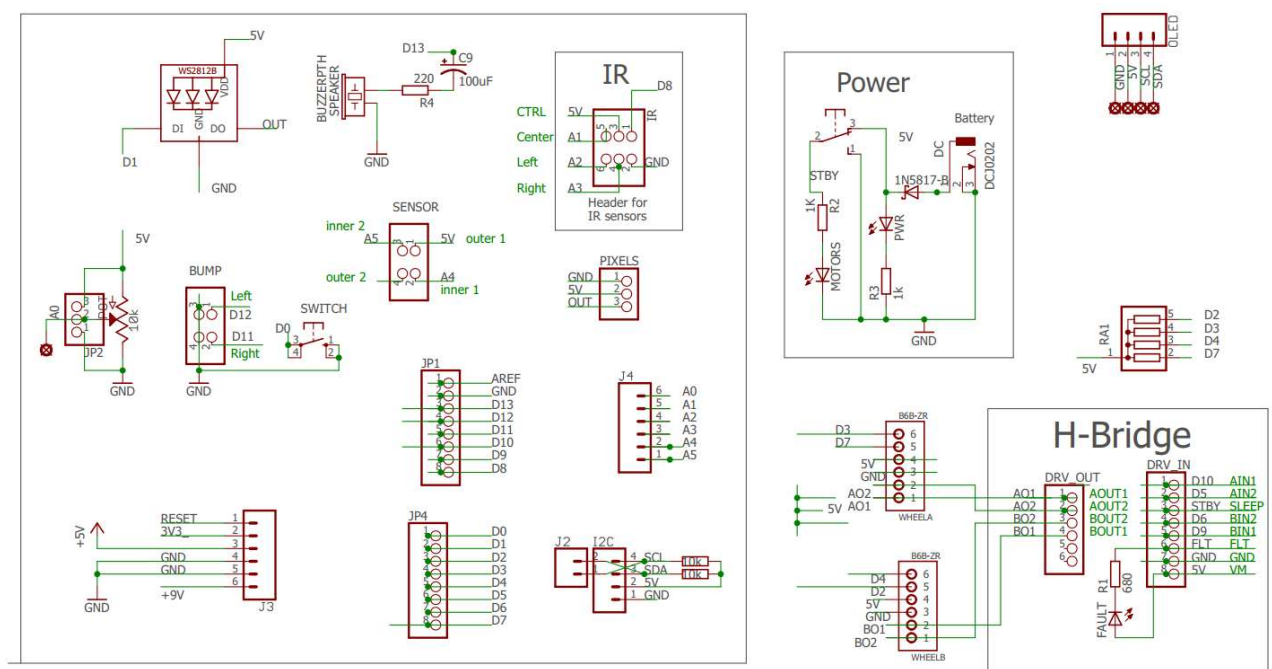
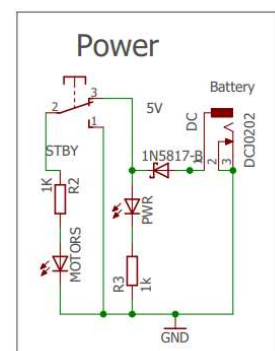
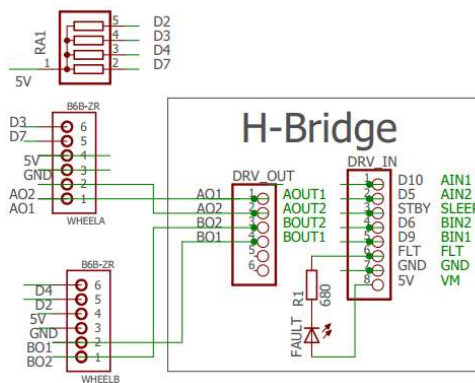
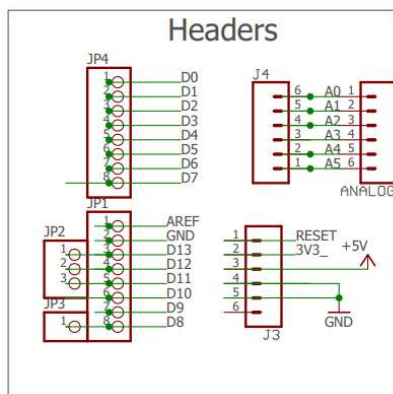
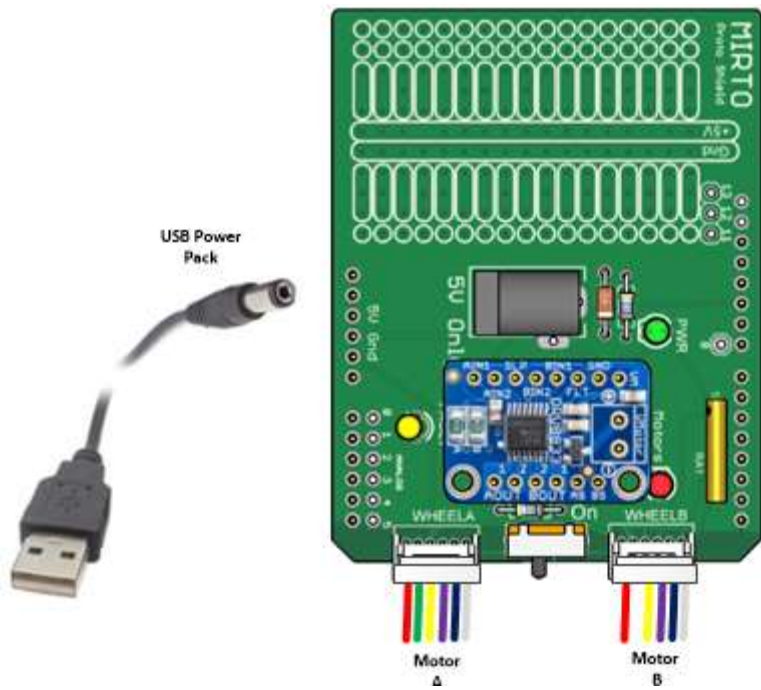


Figure 17: Schematic Diagram



## Motor Details

The specifications for the motors measured at 6 volts are as follows:

### NO LOAD:

Current: < 0.15 Amps Max

Speed:  $197 \pm 10\%$  rpm

### ON LOAD :

Torque: 0.7kg.cm

Current: < 0.54A Max

Speed:  $158 \pm 10\%$  rpm

### STALL:

Current: < 2.87 Amps

Torque 4kg.cm

Gearbox Ratio 1:34

Maximum Motor Drive Voltage: 8.4 Volts

