

Mirto 2017 Build Information

Document Version 1b (draft)

Last updated May 10 2017 by Michael Margolis

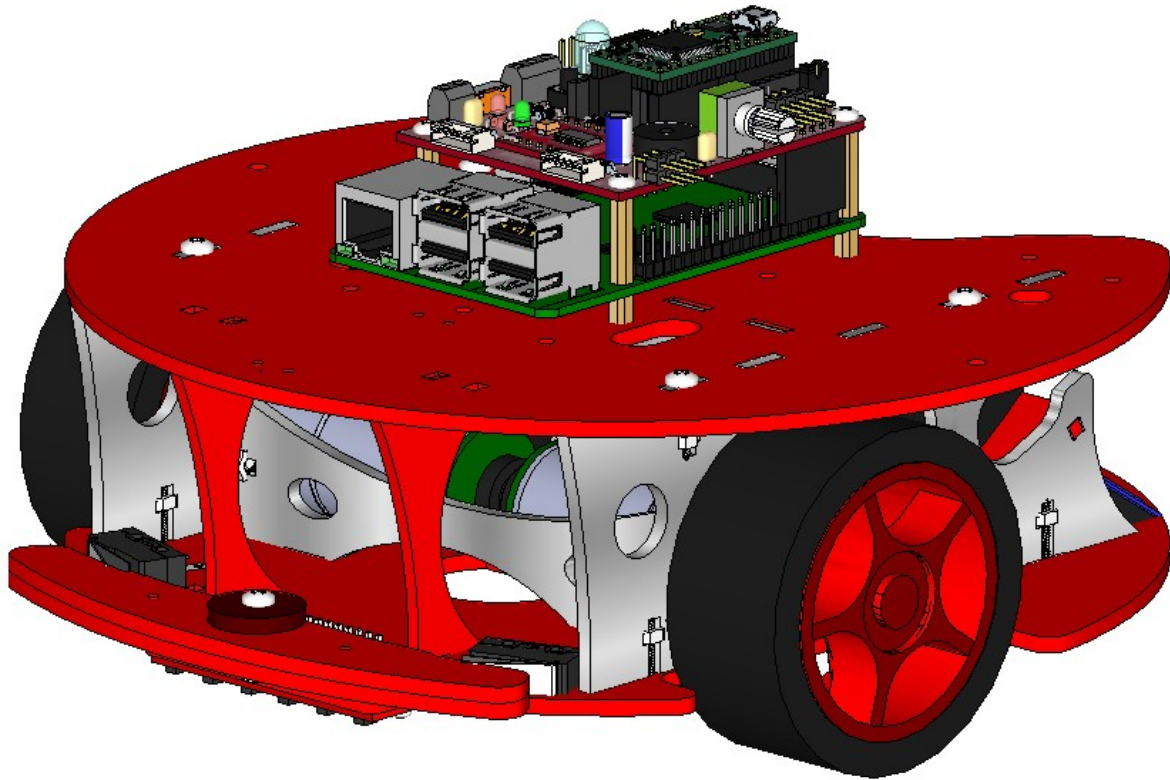


Figure 1: Front View of Robot

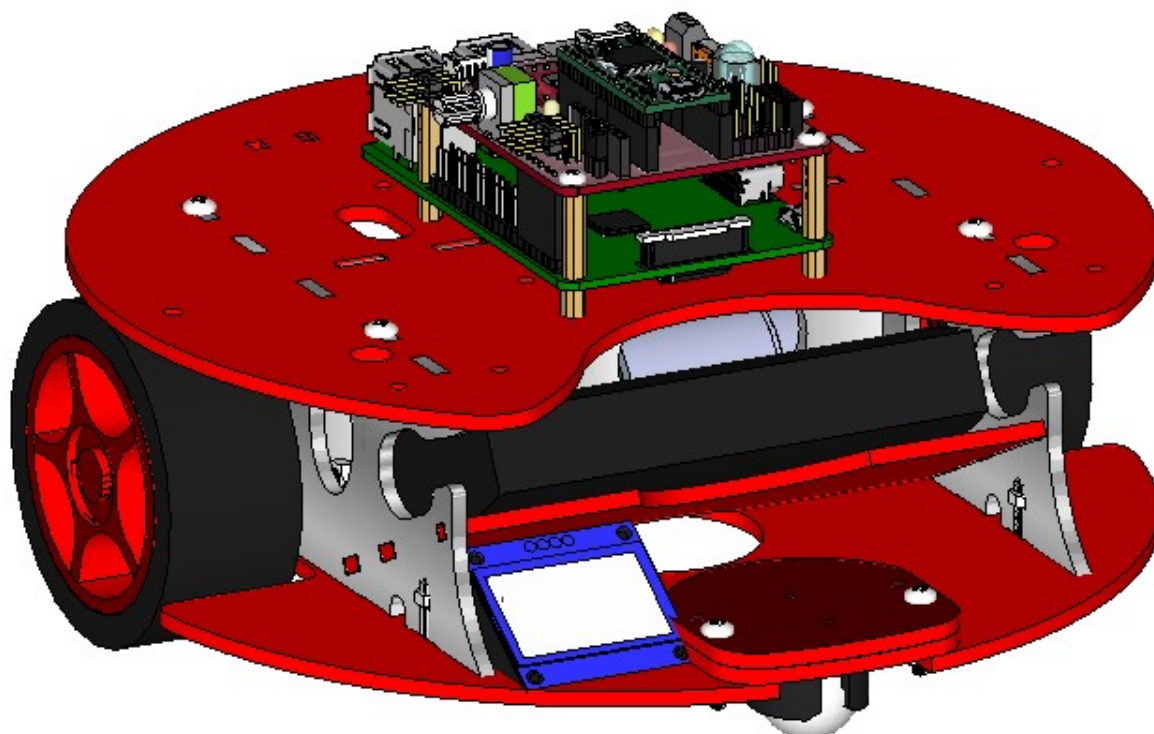
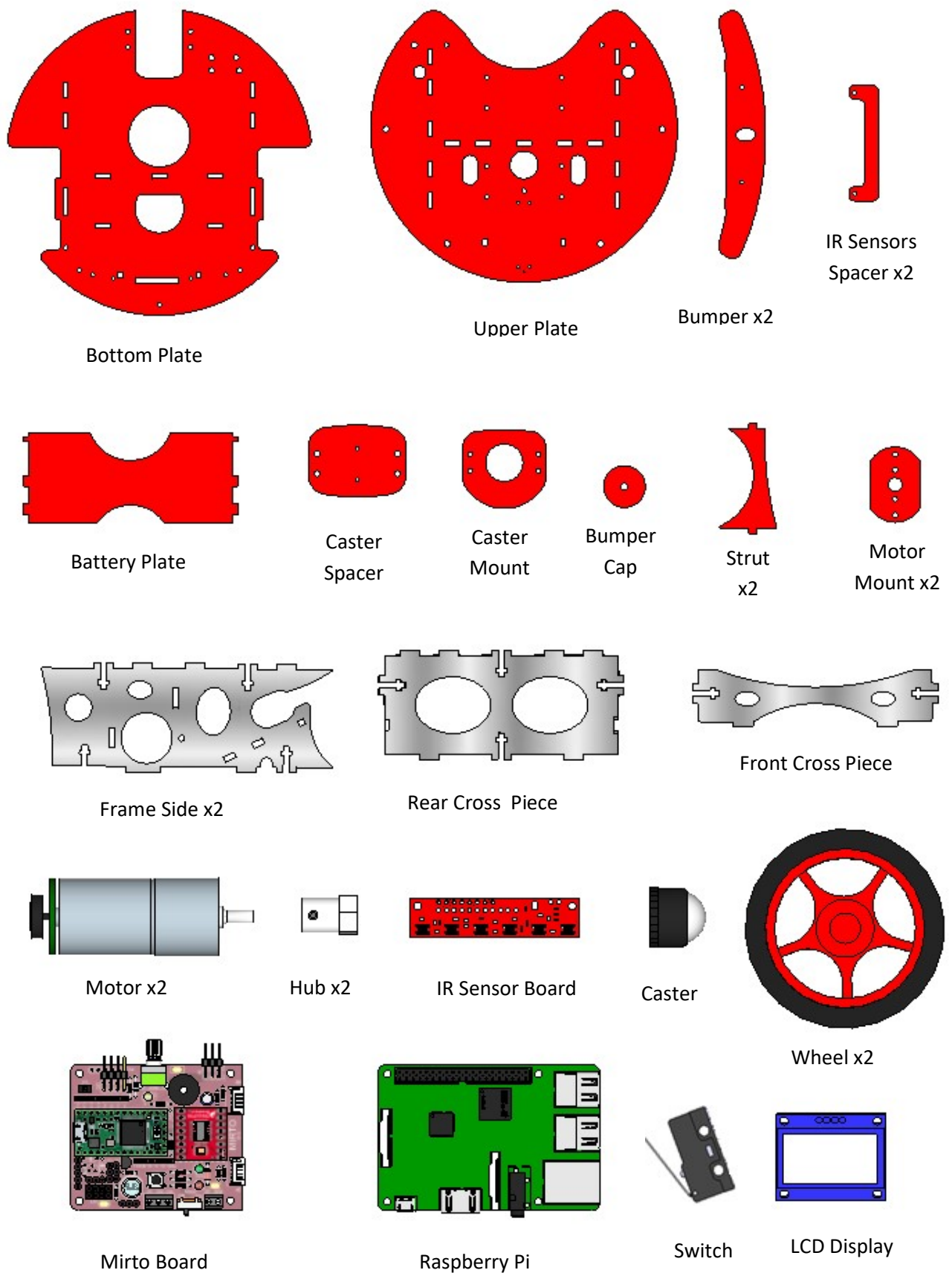


Figure 2: Rear View

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

Figures are not to scale



Hardware:

Quantity	Description	
4	M3 x 5 socket button screw	
16	M3 X 12 pan head machine screw	
24	M3 nut	
1	M3 X 20 socket button screw	
1	Plastic washer	
1	M3 X 6 spacer	
1	M3 locknut	
1	Nylon dome nut	
8	M2.5 x 12 pan head machine screw	
12	M2.5 nut	
2	M2 X 12 pan head machine screw	
2	M2 nut	
2	M3 X 16 pan head machine screw	
2	M4 X 8 pan head machine screw	
4	M2.5x5 threaded spacers for Pi	
4	M2.5x16 threaded spacers for Mirto PCB	

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

Attach motors to mount using two M3x5 socket screws. Don't over-tighten these (hint – hold the shorter end of the hex key using only two fingers when tightening). **Caution – you must use the M3x5 hardware specified, longer screws will damage the gearbox!**

Hardware: 4 off M3x5 socket button screws

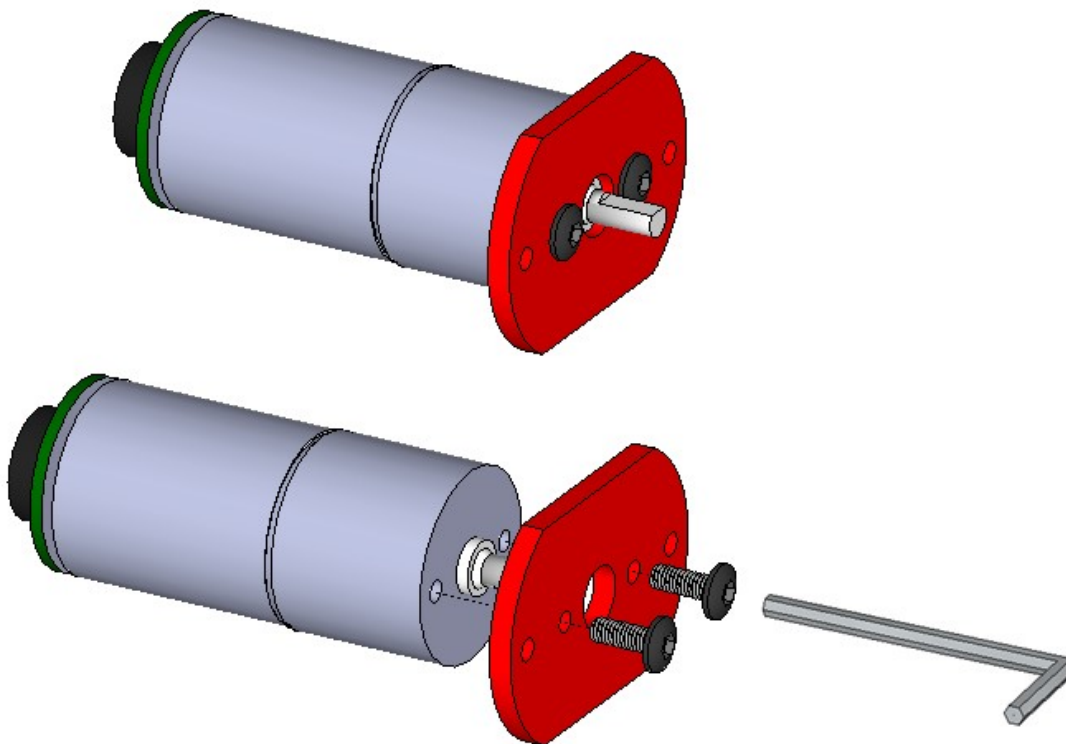


Figure 3: Motor Mount

Assemble the center frame using the two aluminium side pieces, two cross pieces and one acrylic battery platform.

Hardware:

2 off M3x12 pan head machine screws

4 off M3 nuts

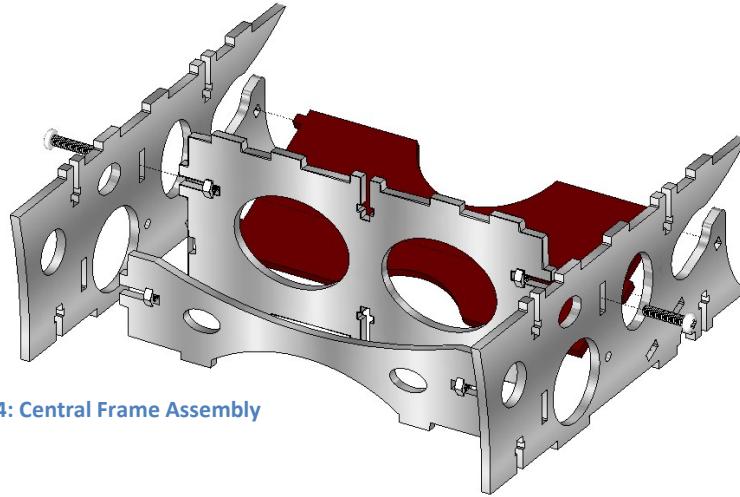


Figure 4: Central Frame Assembly

Four M3 nuts must be inserted into the slots on the cross pieces. The nuts are a tight fit and will only go into the slots when oriented as shown in figure 6a. You may need to use a little force if the slot is cut slightly narrow.

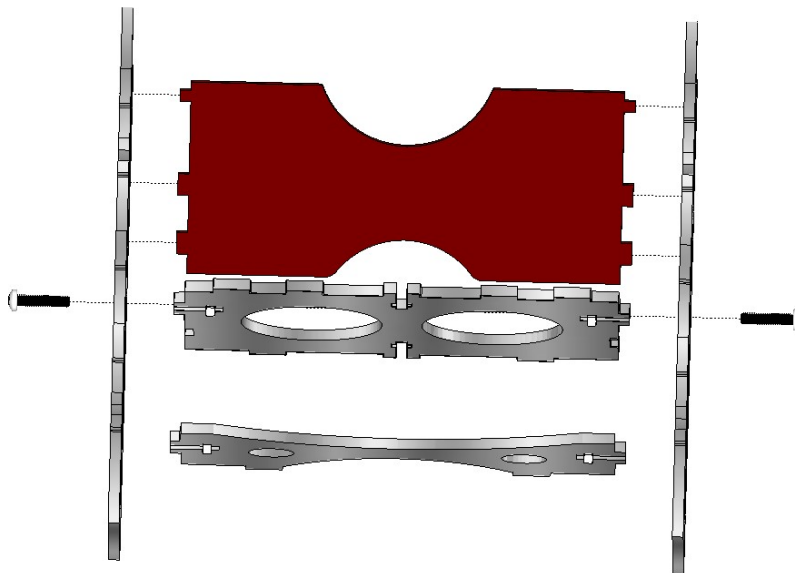


Figure 5: Central Frame from above

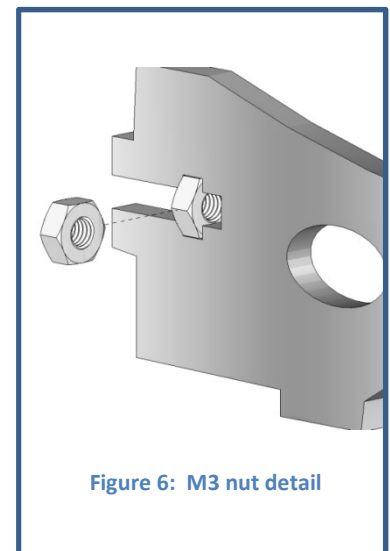


Figure 6: M3 nut detail

The screws holding the smaller cross piece will be added in the next step but it will be easier to insert the nuts now before the motors are attached. Tip: if the nuts do not stay in place you can hold them with a small piece of masking tape.

Attach the motor assembly to the center frame using M3x12 machine screws. The screw holding the front (smaller) cross piece uses the nuts added in the previous step.

Hardware:

4 off M3x12 pan head machine screws

2 off M3 nuts

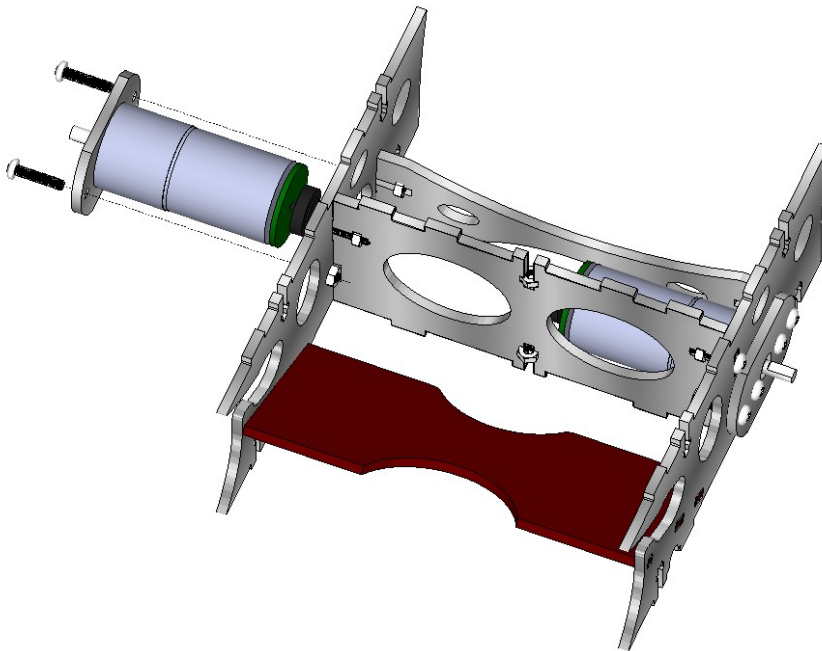
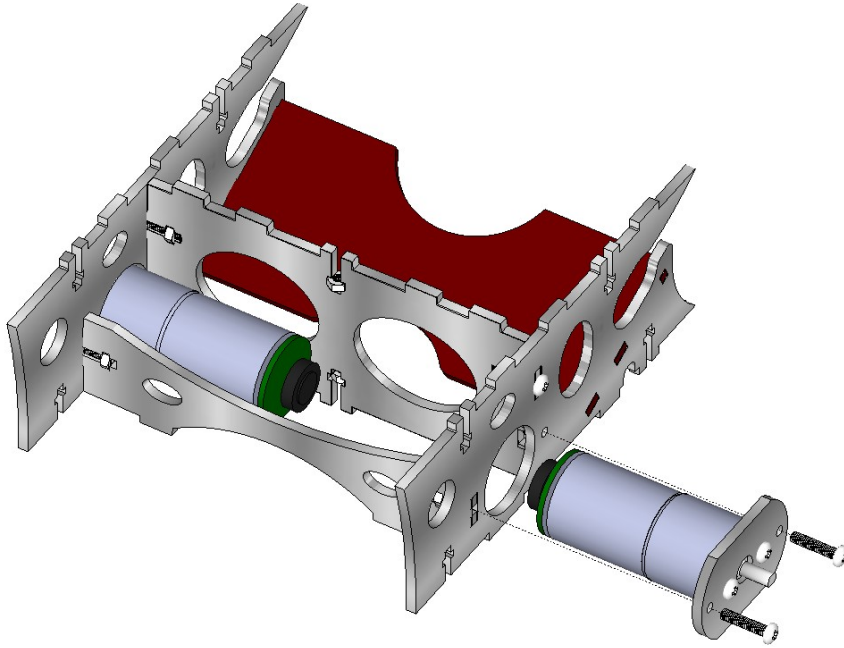


Figure 7: Motor Attachment to Frame

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.

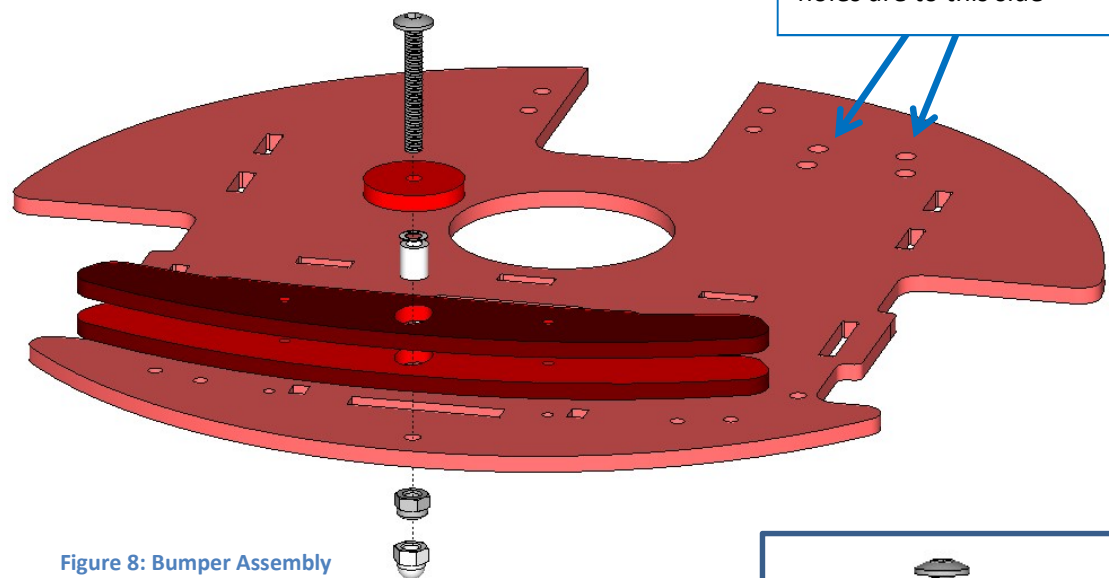
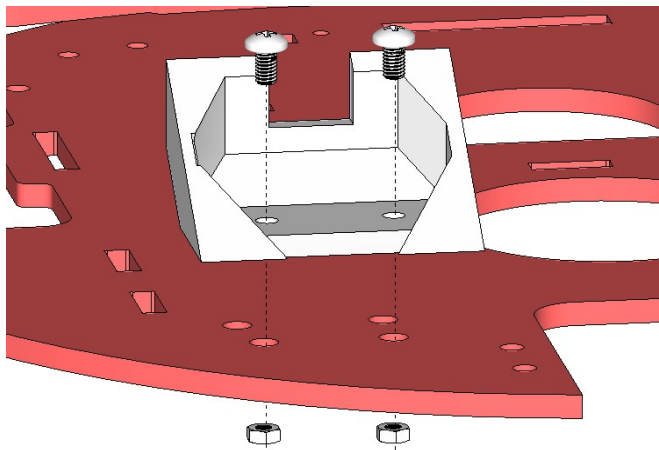


Figure 8: Bumper Assembly



Attach LCD bracket using two M2.5x12 screws and nuts

Hardware:

- 1 off M3x20 socket button screw
- 1 off M3 plastic washer
- 1 off M3 6mm spacer
- 1 off M3 lock nut
- 1 off M3 plastic dome nut
- 2 off M2.5x12 pan head screws
- 2 off M2.5 nuts

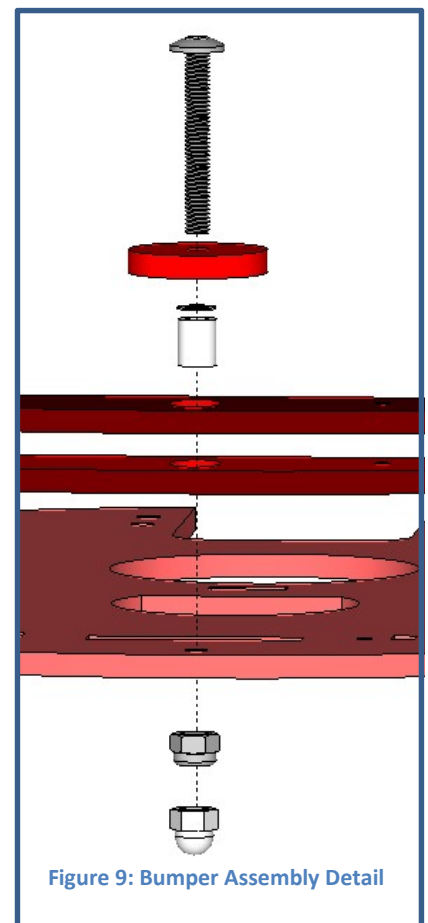


Figure 9: Bumper Assembly Detail

Attach the bump switches using M2.5x12 machine screws. Note the orientation of the switch levers (the hinges on both switches are towards the outside of the plate) and take care not to pull the ribbon cable apart.

Hardware:

4 off M2.5x12 pan head screws

4 off M2.5 nuts

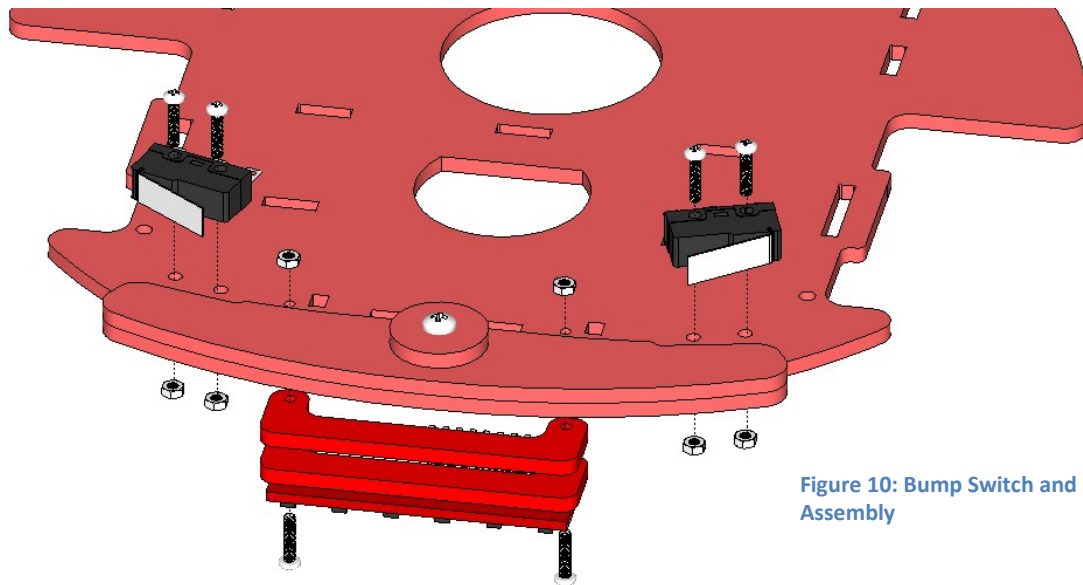


Figure 10: Bump Switch and IR Sensor Assembly

Two acrylic spacers are used to position the IR sensor board under the robot. Use M2x12 pan head screws and M2 nuts to secure the IR sensor board and spacers to bottom plate.

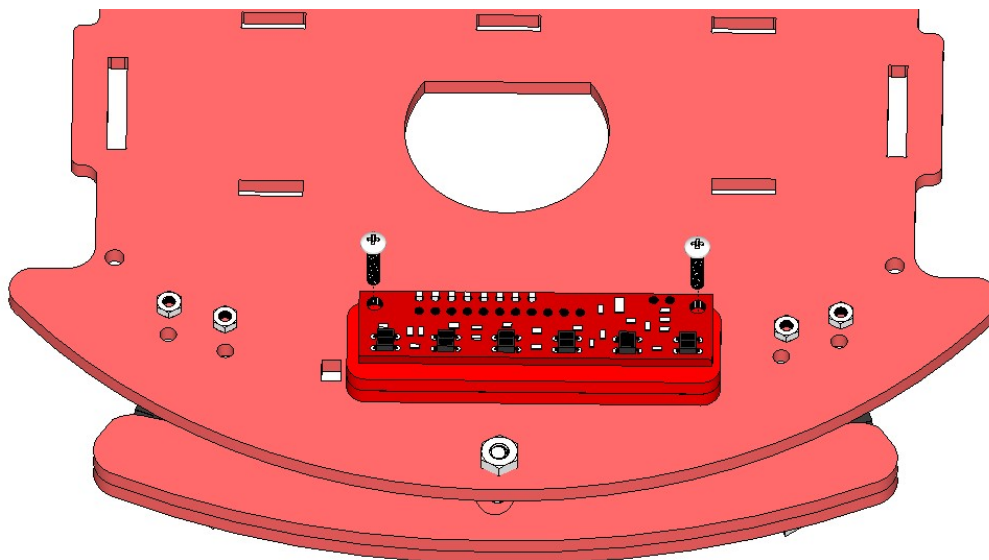


Figure 11: IR Sensor Detail (view from below)

Hardware:

4 off M2x12 pan head screws

4 off M2 nuts

Attach the bottom plate to the central frame using four M3x12 machine screws and nuts.

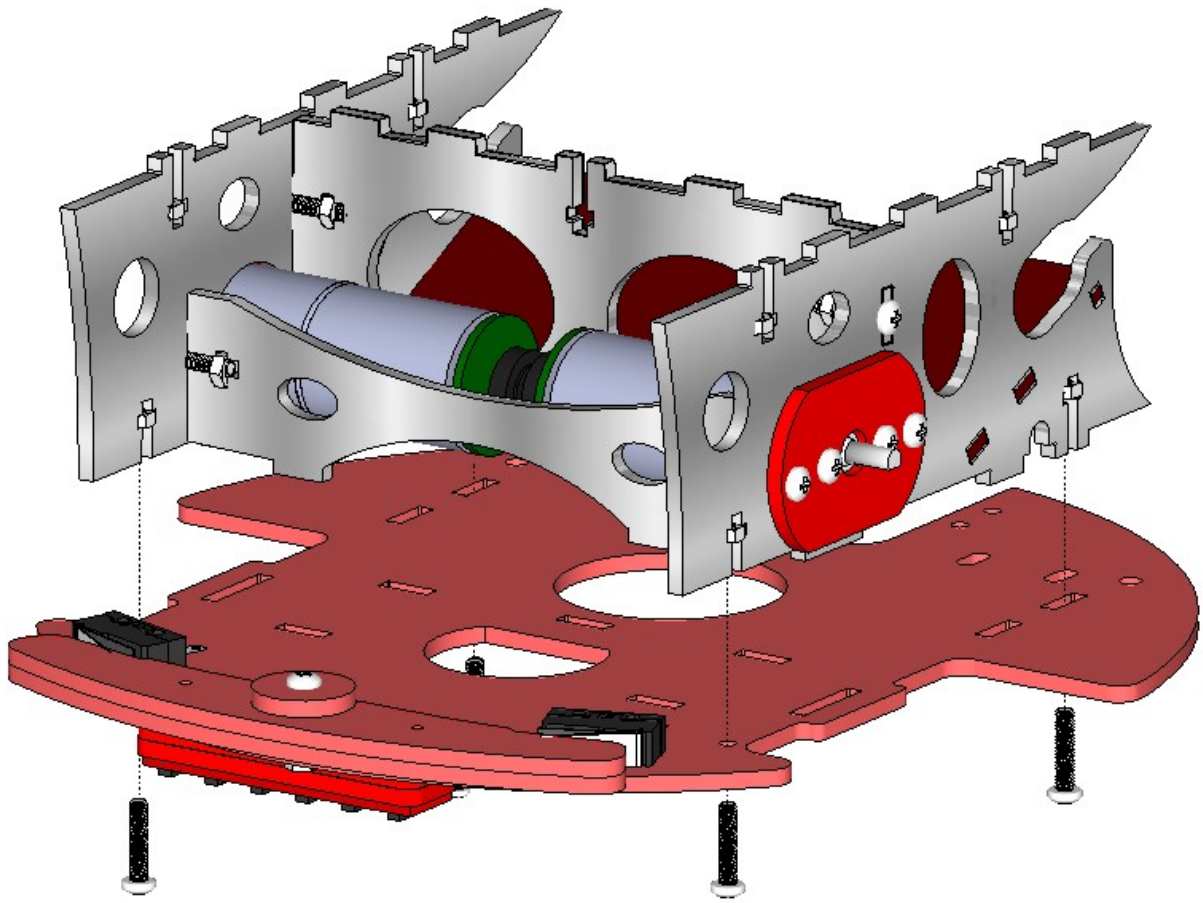


Figure 12: Attaching Bottom Plate to Frame

Hardware:

4 off M3x12 pan head screws

4 off M3 nuts

Assemble the caster mount. Remove the steel ball from the ABS caster housing and use the two small self-tapping screws supplied with the caster to secure the caster housing to the mount. Then push the ball back into the caster housing.

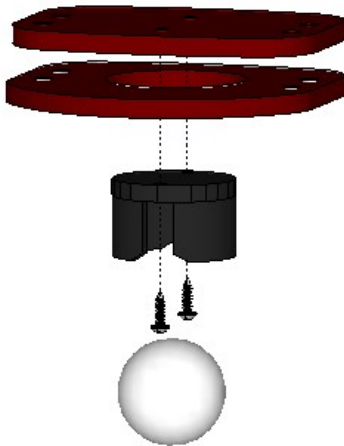


Figure 13: Assembling the Caster

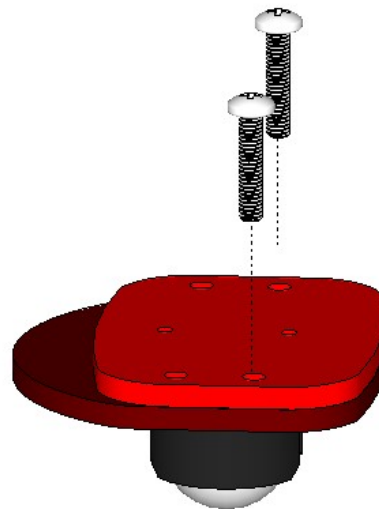


Figure 14: Note orientation of the acrylic pieces

Hardware:

2 self-tapping screws supplied with caster

Attach the caster assembly using M3x16 machine screws. The rear edges of the castor acrylic spacer and top should be flush with the curve of the bottom plate.

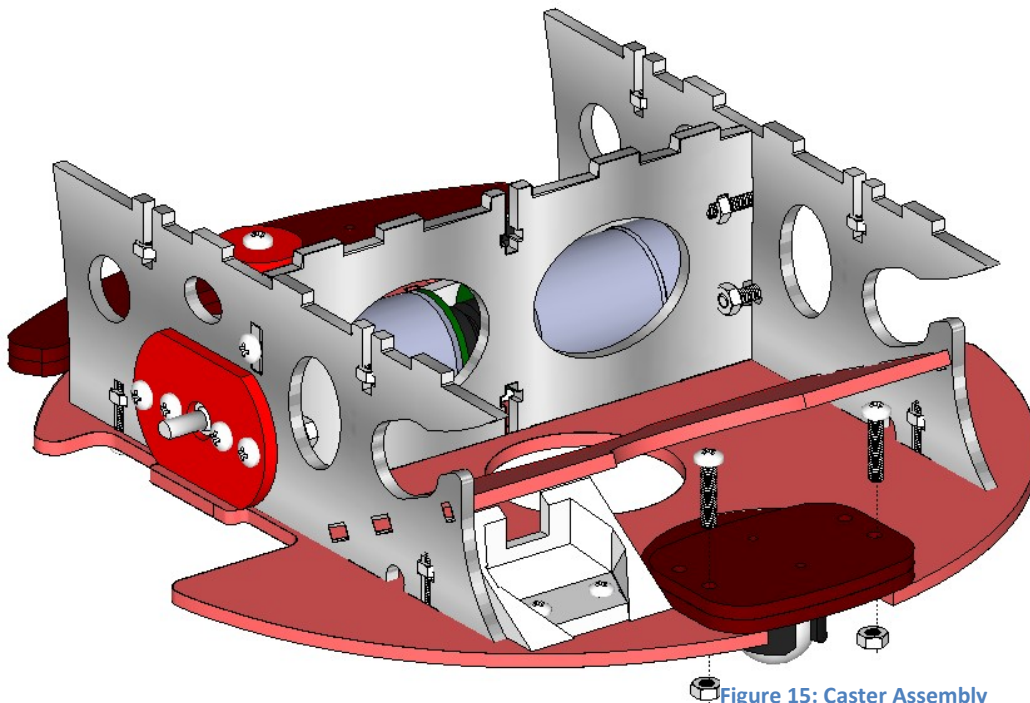


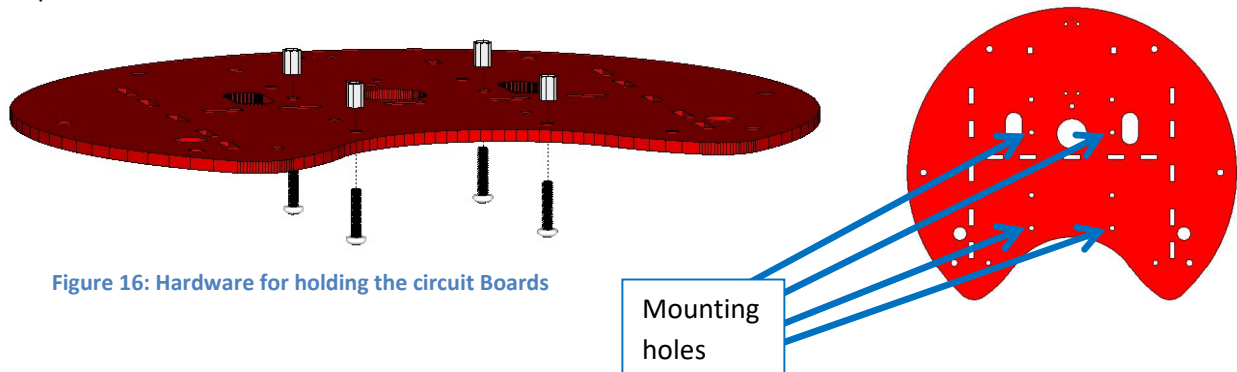
Figure 15: Caster Assembly

Hardware:

2 M3x16 pan head screws

2 M3 nuts

Insert four M2.5x12 machine screws from underneath the upper plate and secure with M2.5x5 hex spacers. These will be used to mount the circuit boards.



The hardware should be tightened so the screws protrude above the upper plate. The Raspberry Pi will be placed onto these bolts at a later stage. This method of assembly is used so the circuit boards can be easily removed when the robot is fully assembled and the bottom of this plate is not easily accessible.

Hardware:

4 M2.5x12 pan head machine screws

4 M2.5x5 threaded spacers

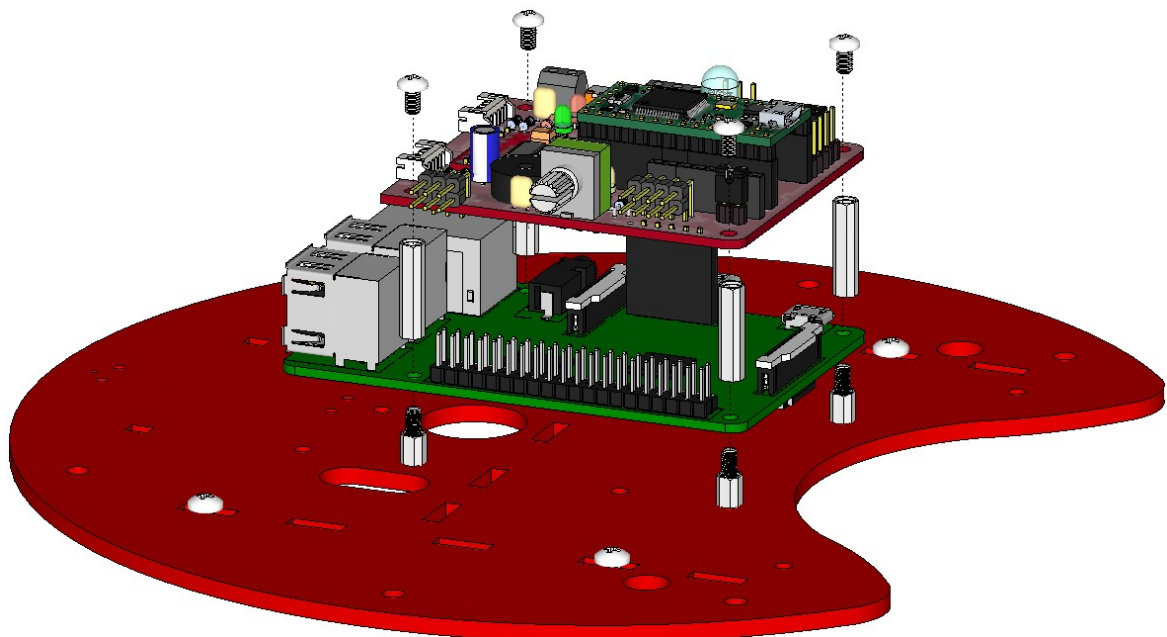


Figure 17: Mounting the Circuit Boards, this step may be performed after the robot assembly is completed

Hardware:

4 M2.5x8 pan head machine screws

4 M2.5x16 threaded spacers

Attach the upper plate to the central frame using four M3x12 machine screws. **Note that the two support struts must be fitted during this step.** The square tabs at the ends of the struts fit into slots on the upper and lower plates.

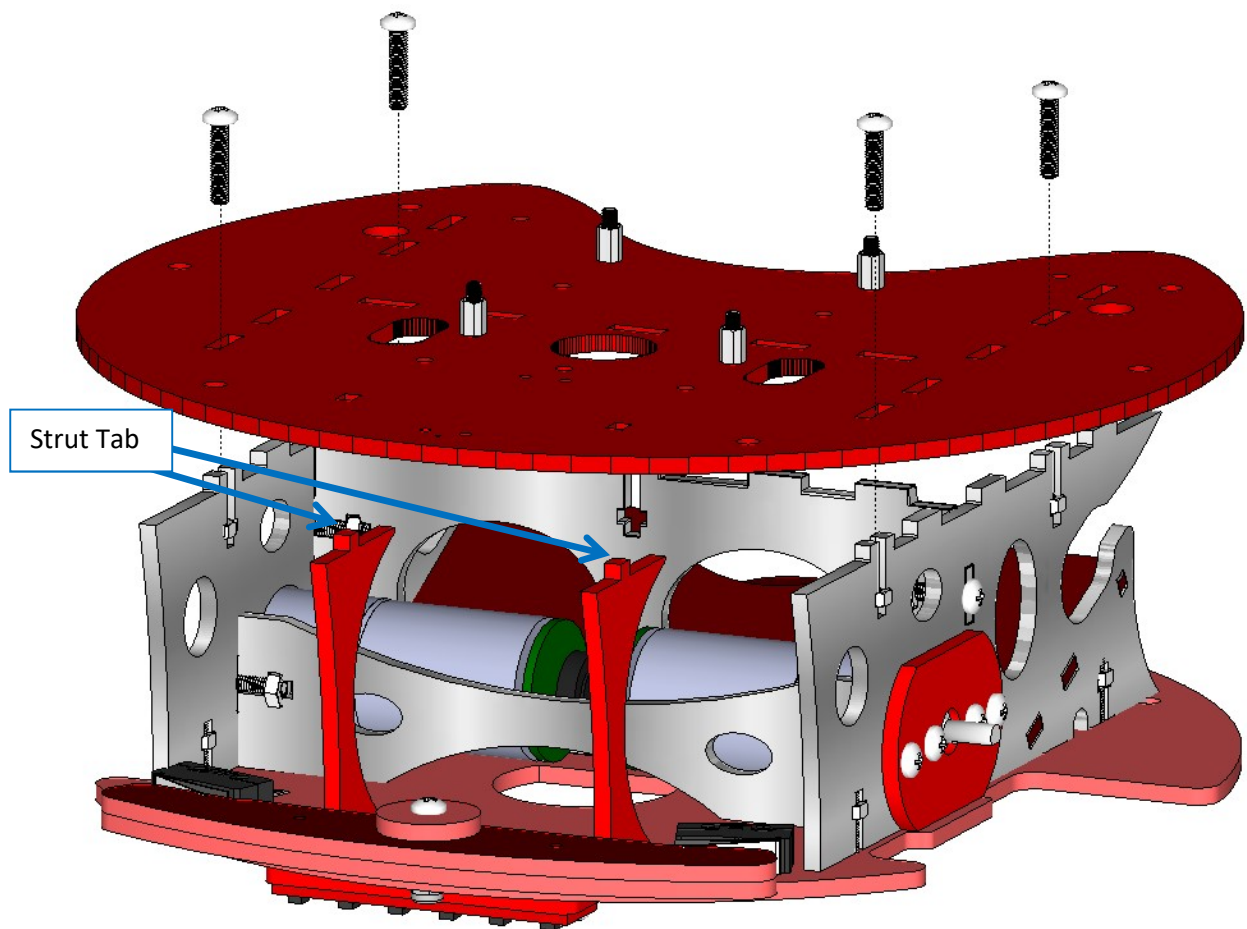


Figure 18: Attaching the Middle Plate and Support Struts

Hardware:

4 off M3x12 pan head screws

4 off M3 nuts

Insert M3 nuts into slots on the wheel hubs and insert grub screws to keep the nuts in place. Align the flat on the motor shaft with the grub screw and push onto the shaft. **It is important that the hub is not rubbing against the motor mounting screws; the gap can be paper thin.** Tighten the grub screw to secure the hub.

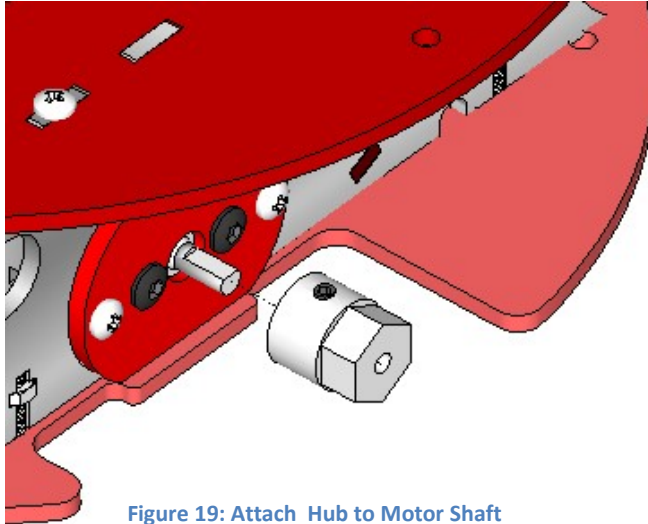


Figure 19: Attach Hub to Motor Shaft

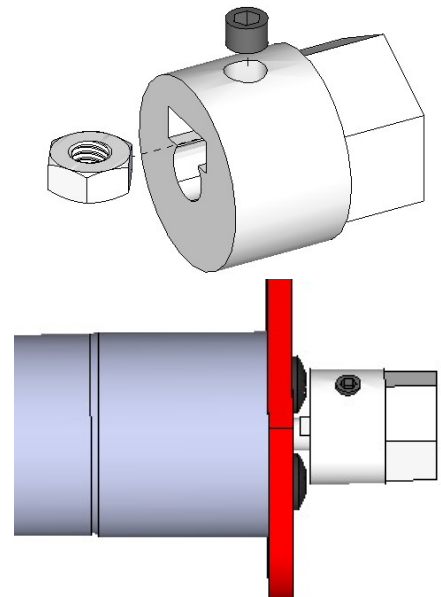


Figure 20: Detail showing Hub Mounted on motor

Push wheels onto the hubs and secure with M4 pan head screws.

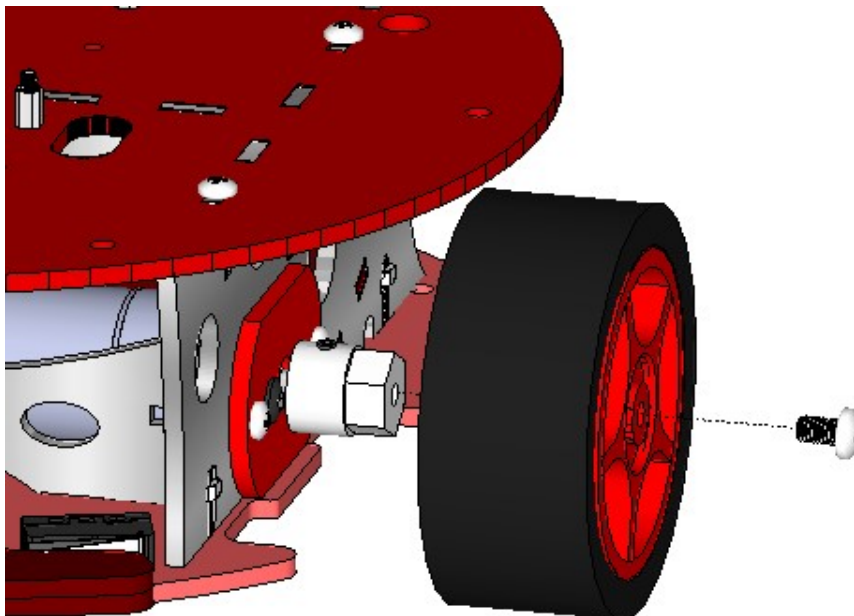


Figure 21: Attaching Wheel to Hub

Hardware:

2 off M3 grub screws

2 off M3 nuts

2 off M4x8 pan head machine screws

Electronic Assembly and Wiring Information

The IR Sensor Connector Board is made by soldering the eight pin header inserted from underneath, then solder the six pin header to the top. The IR sensors are connected to the main circuit board using a 6 conductor IDC cable.

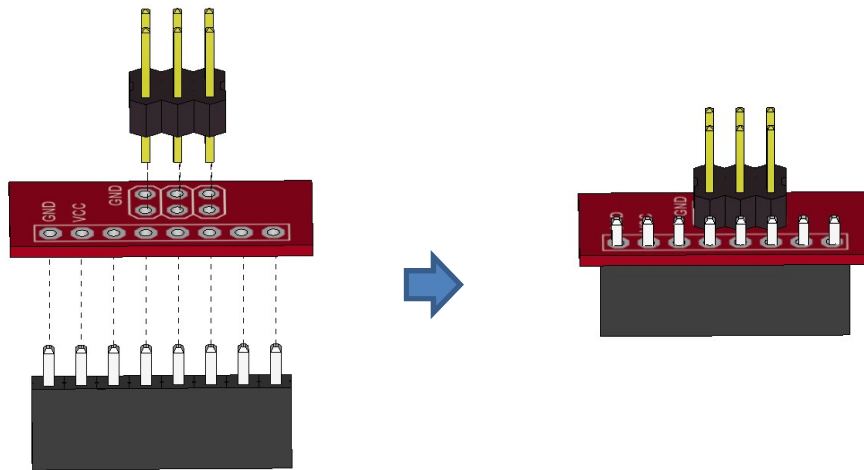


Figure 22: IR Sensor Connector Board

The bump switch assembly is made by soldering 20 cm of four conductor ribbon cable to the switches as shown. Strip 5mm of the other end of the cable and tin the ends so they can be easily attached to the terminal block on the circuit board. Note that the left switch is connected to the terminal marked D6 and the right to D33.

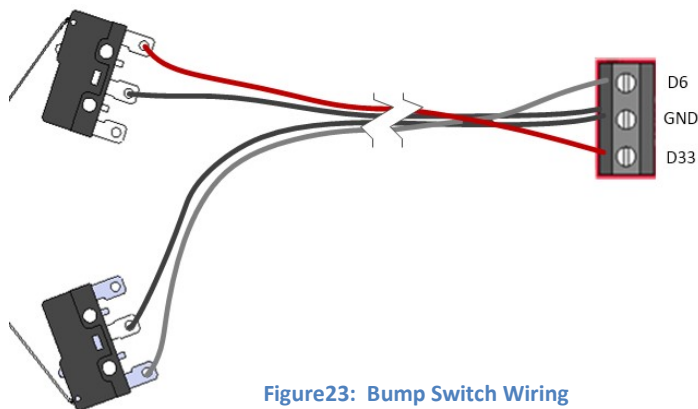


Figure23: Bump Switch Wiring

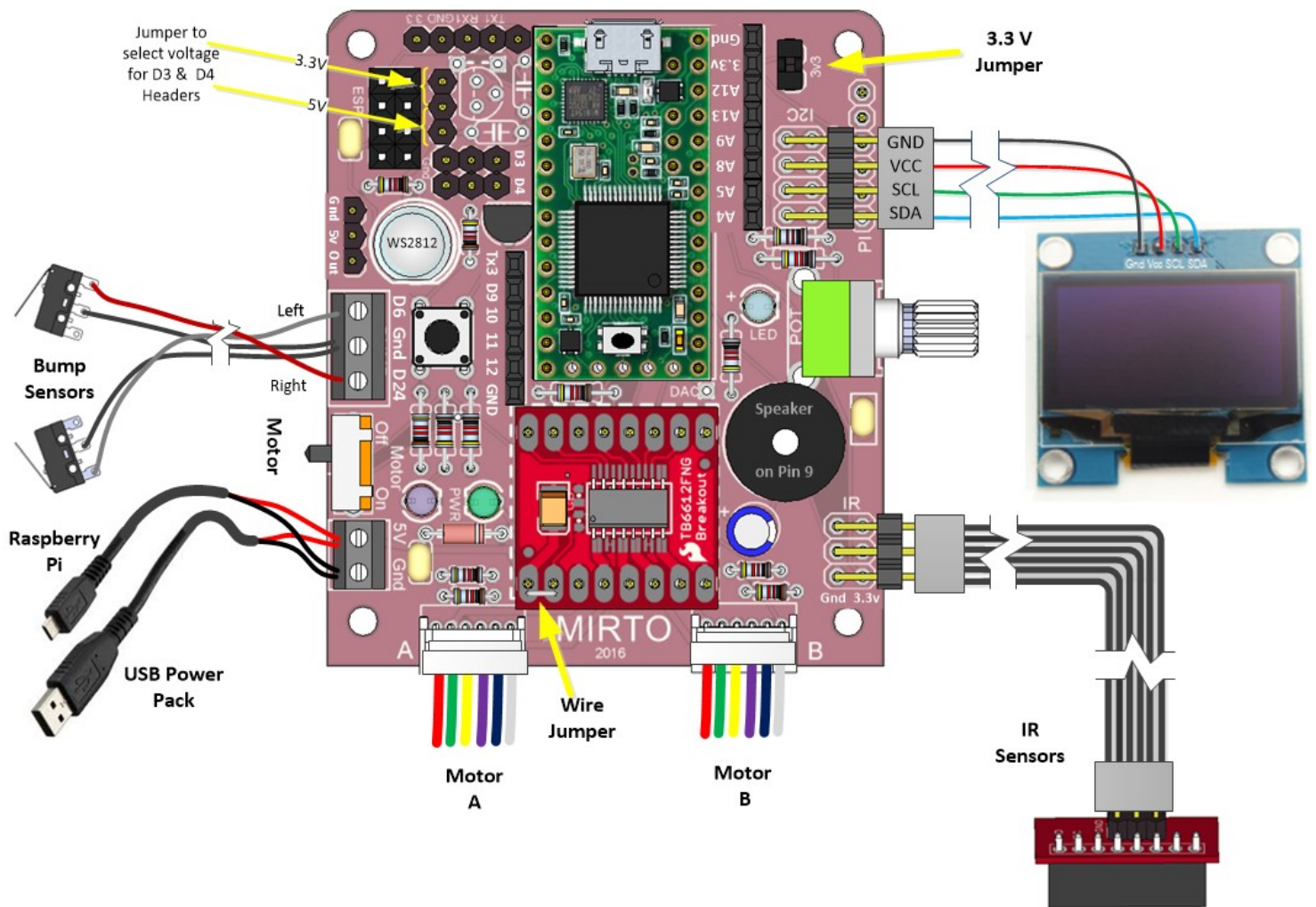


Figure 24: Mirto Board Wiring

Circuit board Schematic

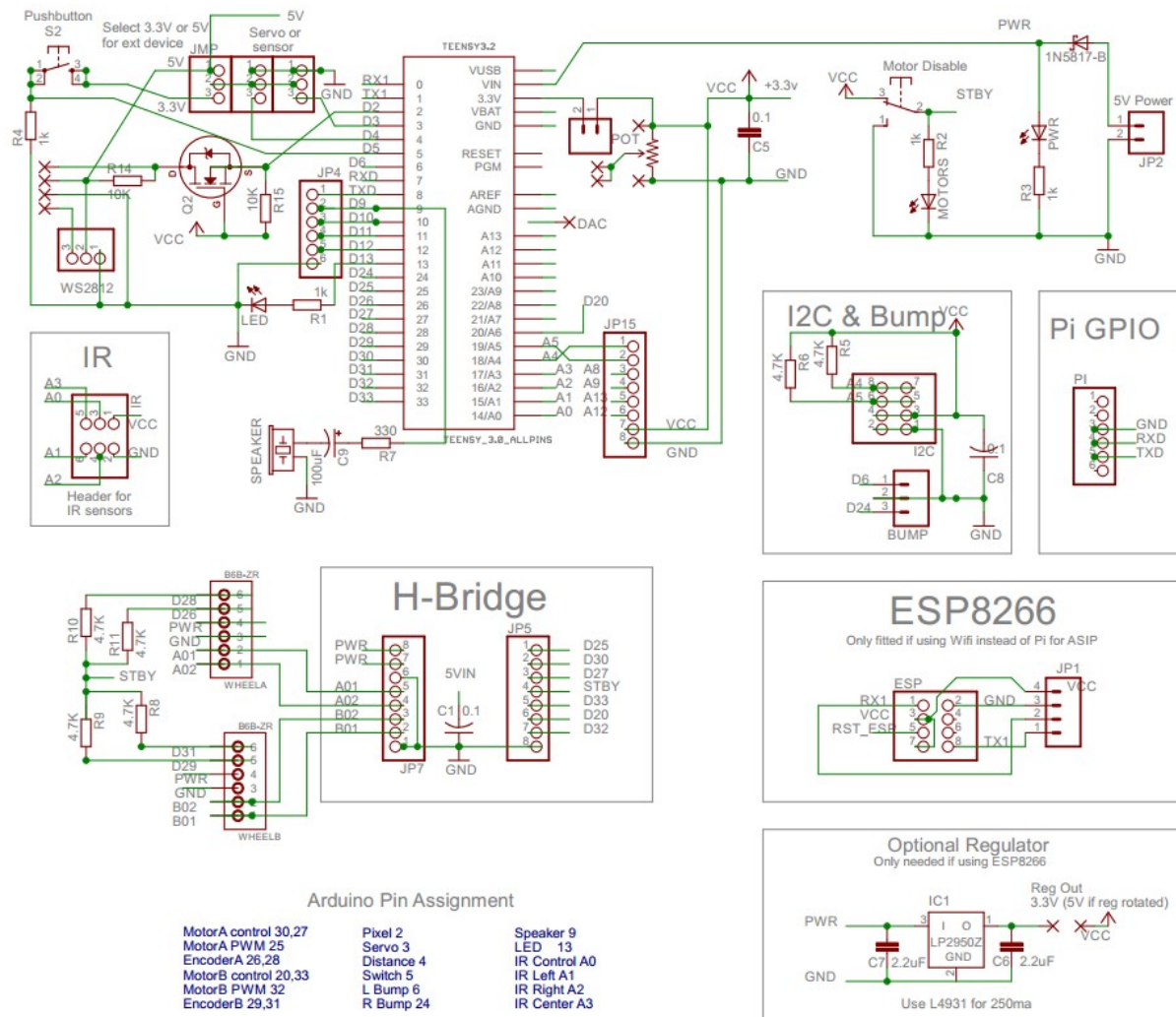


Figure 25: Schematic Diagram

Regulator is only fitted if using ESP8266 WiFi module with Teens 3.1

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

