Edu-AMR
Assembly Instructions

Parts List

	Part Name	Part Description	Qty
1	12V Encoder Gear Motor w/ Mounting Bracket 65mm Wheel	25D 12V Encoder Gear Motor w/ Mounting Bracket 65mm Wheel	2
2	Motor Bracket Screws	M3-.50 x 10	8
3	Motor Bracket Washers	3 mm	8
4	Motor Bracket Lock Nuts	M3 - .50	8
5	Caster Wheel	Waxman 1 1/4" plate black/gold	1
6	Caster Plate M2.5x10mm Spacers	M2.5x10mm F-F Spacers	4
7	Caster Plate M2.5x6mm Screws	M2.5x6mm Screws	8
8	Caster Plate M2.5 Washers	M2.5 Washers	8
9	Motor Driver L298N	L298N ($12 for Qty 4 on Amazon)	1
10	Motor Cables and Male PCB Connectors	(2) 6 PIN JST PH Female Connector on Both Sides - 200mm 1007 26 AWG	2
11	Mini Bread Board		1
12	2mm Pitch PCB board	Patch Board Connector between L298N, motors, and Arduino Mega	0.5
13	Robot Base	26 Guage Sheet metal 5 3/4" x 7 1/4"	1
14	Robot Shelves	2/25" thick, 5" x 7" Acrylic Sheet First Layer: Base mounting holes only (4).	1
15	Robot Shelves	2/25" thick, 5" x 7" Acrylic Sheet Top layer: First layer mounting holes (4) + Lidar Mounting holes (4).	1
16	MPU 6050	IMU	1
17	Power Switch	Power & RF Enable	1
18	Red LED	Red LED	1
19	LED Resistor	330 ohm	2
20	Pullup Resistors for IMU	4.7k ohm	2
21	Male battery connector	T Plug Male Connector	1
22	PDU strip	PDU strip	1
23	PDU Power Switch Panel	3D print. Drill hole for LED.	1
24	Wire A	M/M - 20 cm. MPU to Mega	4
25	Wire B	M/F - 23 cm. Motor patch brd & L298N to Mega.	11
26	Wire C	F/F - short (10 cm, 2.54 pitch) - Motor Power Controller to Motor connection patch board.	4
27	Wire E	Mod: bared-Female - 10cm. For motor patch board GND to PDU GND	1
28	Spacers, screws, nuts, washers, hex wrench,		
29	Arduino Mega		1
30	USB A to USB B Arduino Mega Cable		1
31	Arduino 5v Power Barrel Connector		1
32	Power Converter USB For Rpi		1
33	Raspberry Pi Power USB Cable		1
34	Raspberry Pi Camera		1
35	Rpi Camera Mount		1
36	64 GB Micro SD Card	SanDisk Ultra For Rpi OS	1
37	Micro HDMI to HDMI Adapter		1
38	Raspberry Pi 4B 4GB	Raspberry Pi 4 Model B 2019 Quad Core 64 I	1
39	RPLidar A1	Slamtec RPLIDAR A1M8 2D 360 Degree 12 M	1
40	RPLidar Micro USB to USB		1
41	RPLidar Screws	M2.5x6mm screws to hold RPLidar legs to t	4
42	RPLidar M2.5 Spacers - Male	M2.5x6+6mm. Needed to extend hight of R	4
43	HDMI Adapter for Headless Display	4K HDMI Dummy Plug - Virtual Monitor Dis	1
44	RF TX/RX	Delinx 4 8 Channels 2.4GHz Long Range RC T	1
45	Battery Voltage Display	Voltmeter 2.5-30VDC LED CHAS MT	1
46	Ties	Small wire ties	
47	Velcro Squares		
48	Double Sided Tape Squares		

Assembly Instructions

Base Frame:

Figure 1: a) Bottom b) Top

1) Caster wheel installation:

   Requires: Caster wheel, 4 x M2.5x10mm spacers, 8 x M2.5x6mm Screws, and 8 x M2.5 washers.

   From the bottom of the caster wheel plate: screw => washer => caster wheel plate => washer => 10mm spacer => bottom of base => screw

   Note: Don't fully tighten until you get all 4 spacers and base screws aligned.

2) Motor bracket installation.
   Requires: 2 x motor brackets, 8 x M2.5 or M3 - .50 x10 screws, 8 x M2.5 or M3 washers and 8 x M2.5 or M3 locknuts.

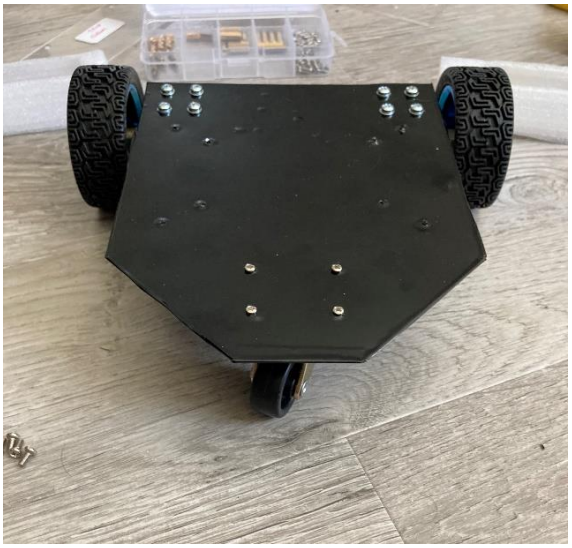
   From the top of the base plate: screw => washer => base plate => motor bracket => nut. Do one bracket at a time. Do not fully tighten the nuts until all 4 screws, washers & nuts are in place. Square bracket to side of base plate (so wheel will not be toed in or out) while fully tightening screws.

3) Use motor screws to attach motors to brackets as shown below. Point 6 pin connectors out the back of the base bottom.

4) Wheel adapter installation.
Screw the two wheel adapter screws (just part way) into each adapter. See photo below:

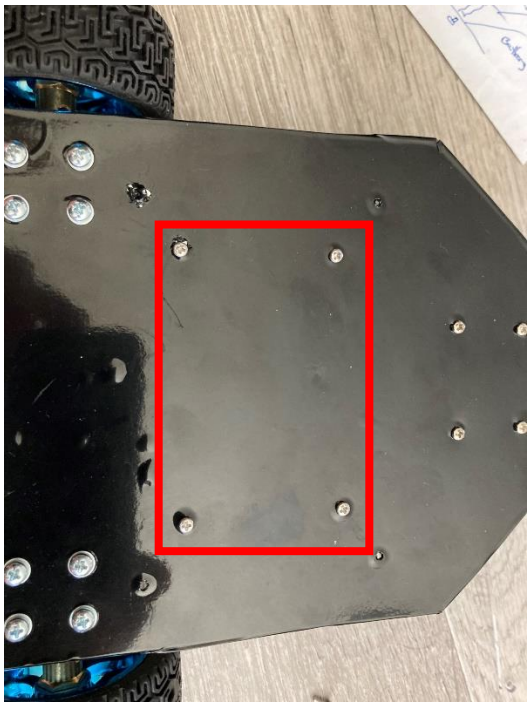
Slip adapter on motor shaft with one of the hex screws perpendicular to the flat side of the shaft. Tighten the perpendicular hex screw first, then the other. Make sure you give a little space between the adapter and the bracket. Otherwise, there will be drag.

5) Screw wheels to adapters with corresponding screws.



6) Battery shelf assembly.
   Parts: 4 x 15mm F-F spacers, 4 x 15mm M-F spacers, and 8 x 2.5mm screws.
   Screw spacer pairs (M-F to F-F) together as show below. This achieves a 30mm battery space.

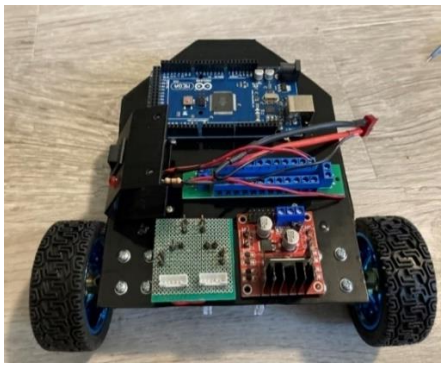
Locate the 4 holes in the center of the base plate for the 4 x 2.5mm screws.



From the top of the base plate: screw => base plate => spacer => battery acrylic shield => screw. Do one column at a time. Additionally, do not fully tighten the crews until all 4 spacer columns are in place. See photos below.

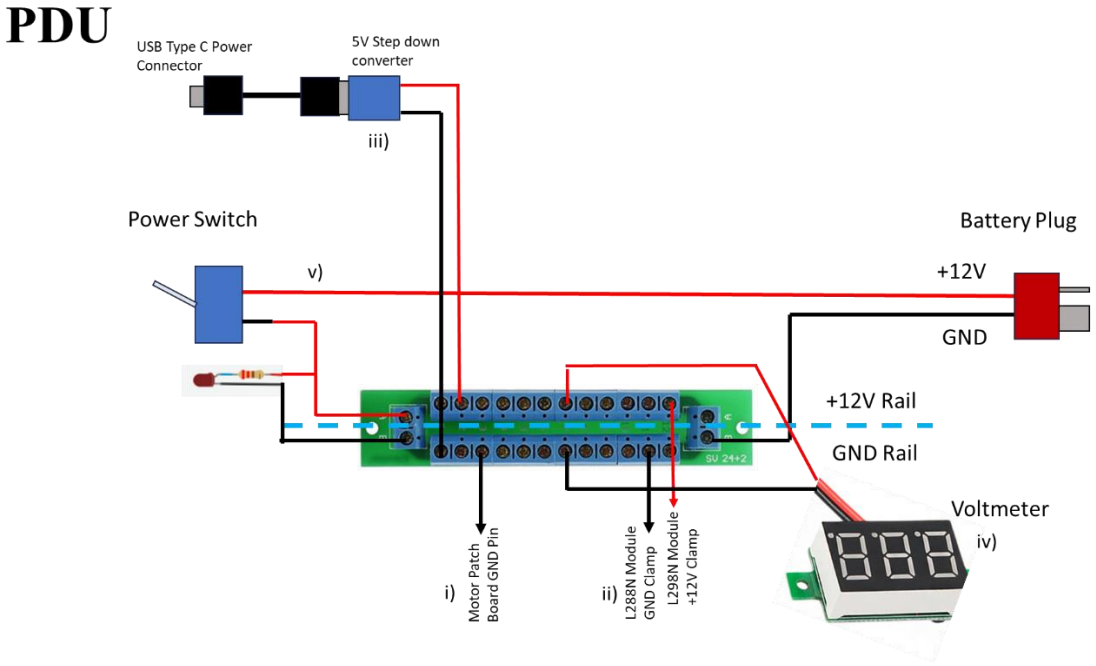
7) Add Power connections to PDU Power strip **before** tacking down the base layer components, as will be performed the next section.

   Since the power stripe sits in the middle of the components, and will be covered by wires passing over it between the Arduino and all the other components, we need to connect all the power wires first. See photo below of base robot with components placed in target positions.



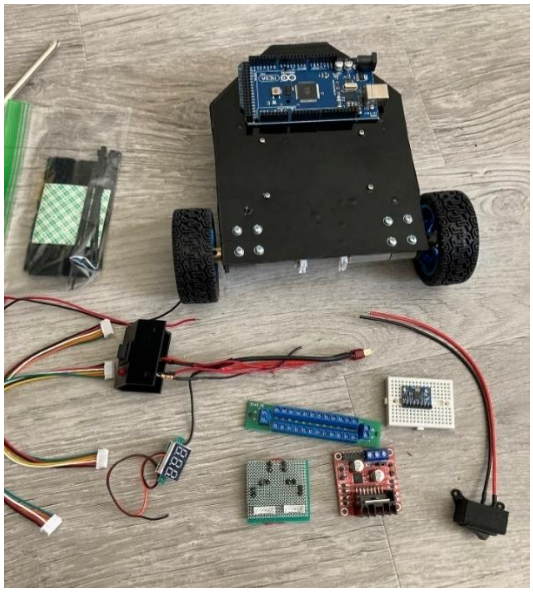
   a) Connect:
      i. Stripped end to Female - 10cm (1). Connect motor patch board GND pin to PDU GND rail.
      ii. Stripped end to stripped end wires (2). Connect 1) L298N GND clamp to PDU GND, and 2) L298N +12V clamp to PDU +12V rail.
      iii. 5V step converter for Raspberry Pi power source to PDU.
      iv. Voltmeter to PDU.

v. Power switch, battery plug, and LED/resistor wire network connects to the PDU as shown in schematic below.

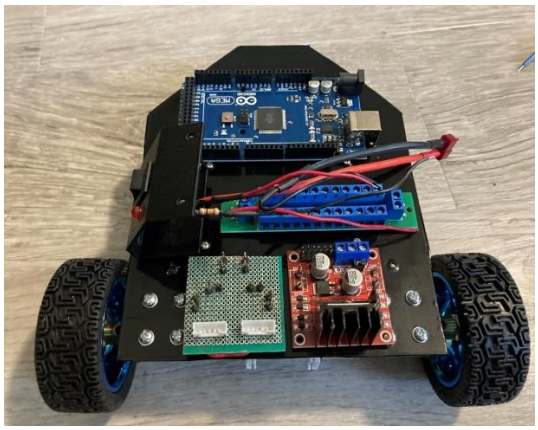


8) Securing Arduino Mega, motor patch board, motor driver board, power strip (PDU), and power on/off switch to the base chassis.

Use double sided tape and Velcro as show in below photos:



Components and base chassis (above photo).



Above Photo: Component Placement.

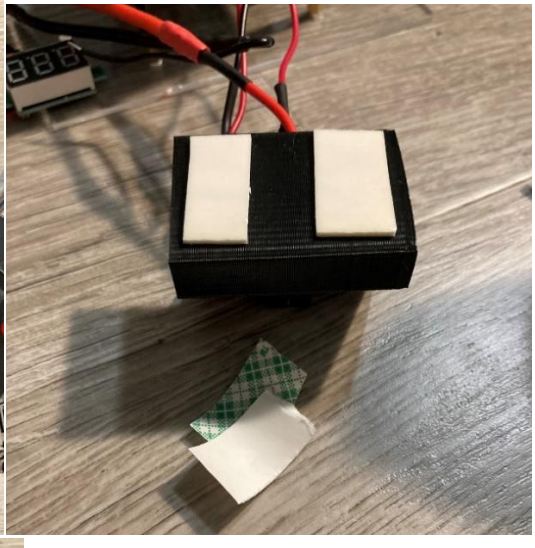
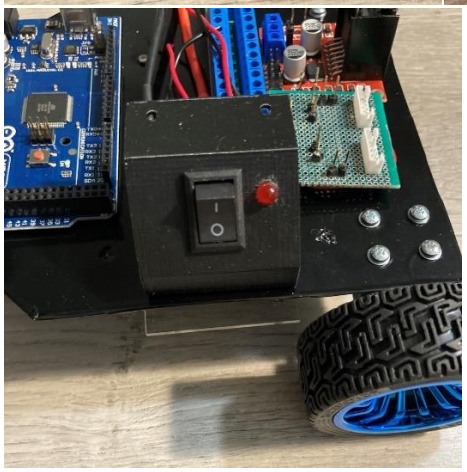
a. Next, secure PDU strip to base surface using Velcro. Place as show above.

b. Then follow series of photos below to attach the remaining components to the base surface.

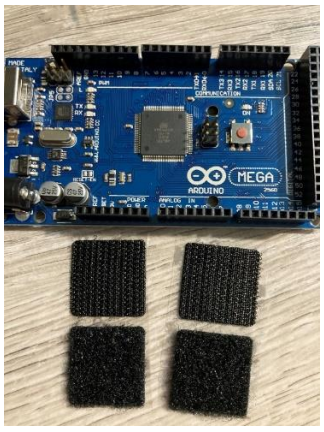
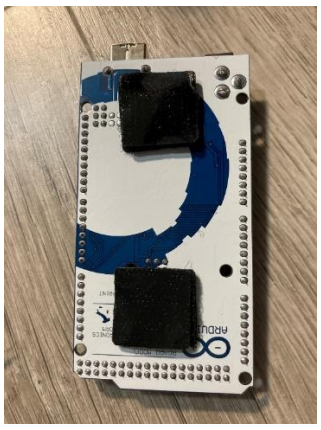
** Note: Double sided tape is very hard to remove from acrylic/plastic and base covering. So, typically items that won't move like switches, and IMU are best tacked down with double sided tape. Else, use Velcro.

Also, not a lot of double sided tape is needed if placed carefully, so cut in half when possible and place evenly on bottom of items so they dont rock and unstick. See photo of power on/off switch below.

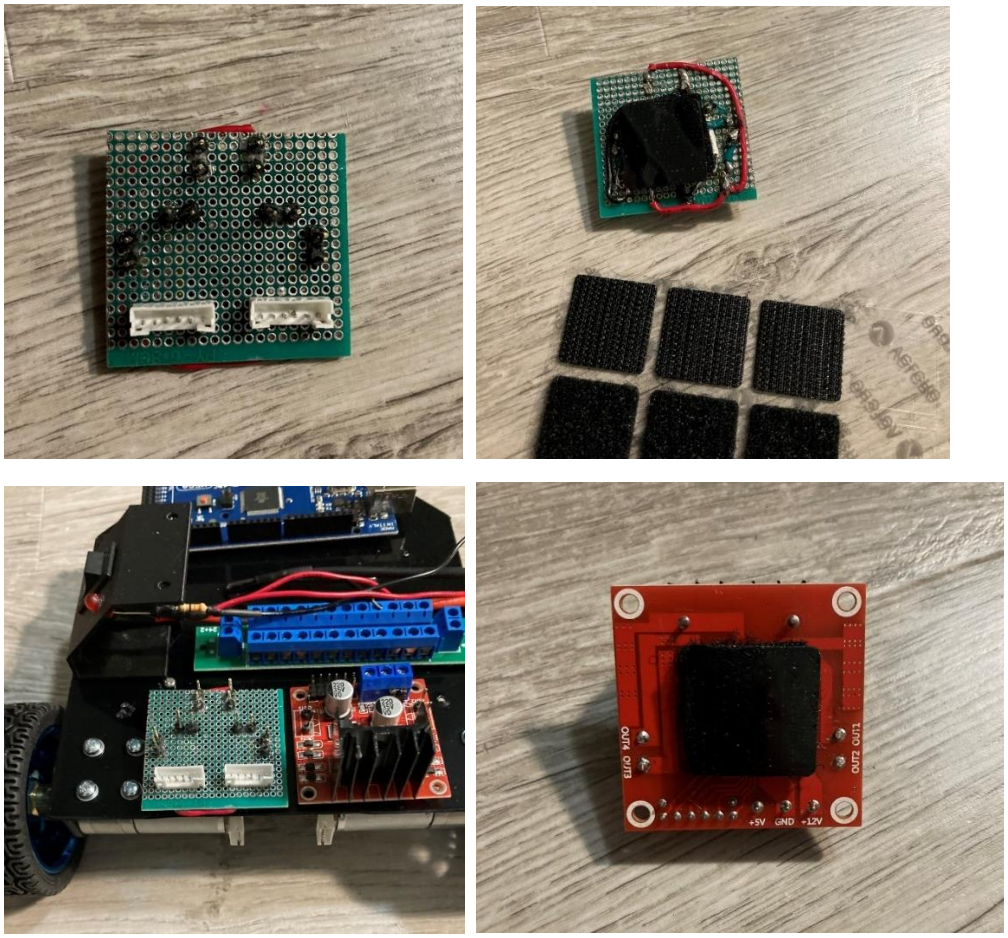
Photo above: Double sided tape.

Photos above: Power Switch attached to base surface using double sided tape.


Photos above: Attaching Arduino Mega to base surface using Velcro.

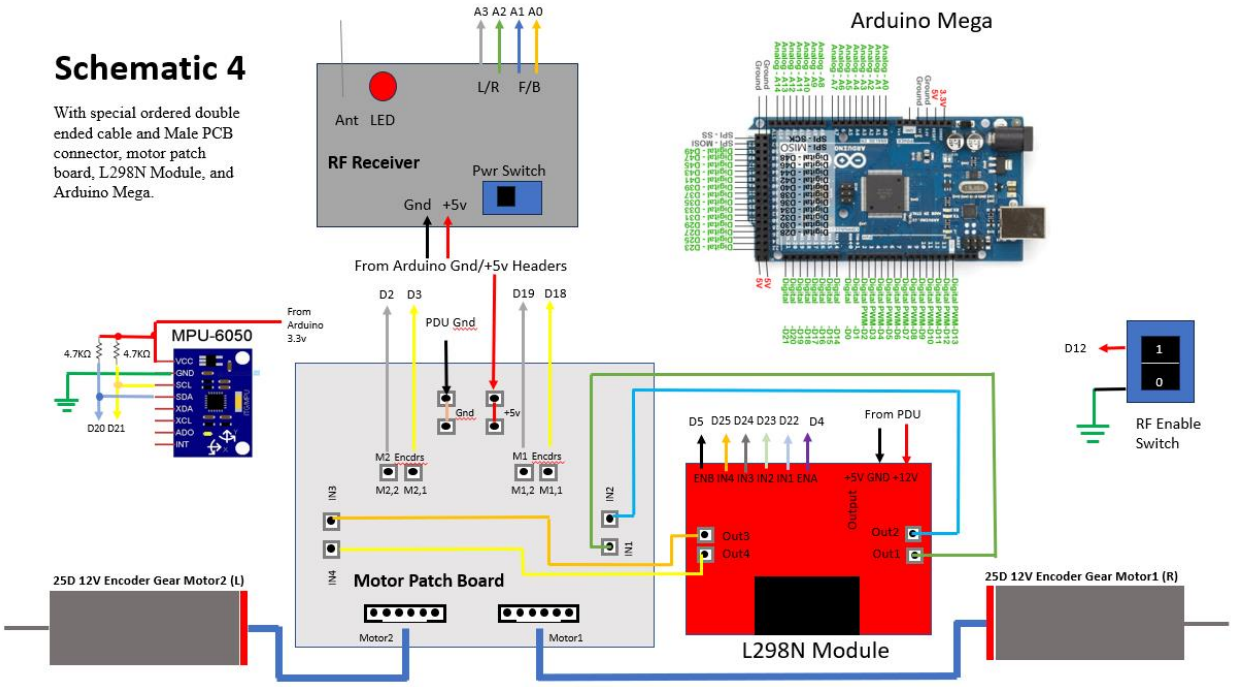


Photos Above: Attaching motor patch board and L298N motor drive module to base surface using Velcro.

9) Base level schematic for RF Receiver, MPU-6050, motors, motor patch board, and RF/RC enable switch.

   All of the connecting wires between the above listed parts need to be installed before placing the first level shelf for the Raspberry Pi, and other component on this shelf.

   The diagram below (labeled Schematic 4) shows the interconnections for the base level connections. We will list the wire size, type and connection points for each wire to be installed.

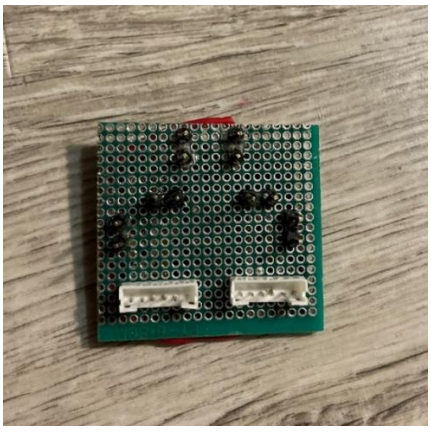


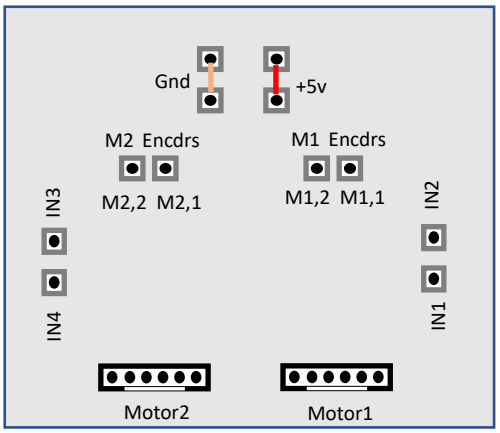
a) Wires: F/F - short (10 cm, 2.54 pitch) - Motor Power Controller (MPC) to Motor patch board (Patch Brd) (Qty: 4).

Connect (reference Shematic 4 above):

i. Patch Brd – IN1 ⇔ MPC – OUT1
ii. Patch Brd – IN2 ⇔ MPC – OUT2
iii. Patch Brd – IN3 ⇔ MPC – OUT3
iv. Patch Brd – IN4 ⇔ MPC – OUT4

a) b)





Motor Patch Board. a) Photo, and b) Schematic.

b) M/F - 23 cm. Motor patch brd & L298N to Mega (Qty: 11).
   i. Patch Brd M2,2 ⇔ Mega D2
   ii. Patch Brd M2,1 ⇔ Mega D3
   iii. Patch Brd M1,2 ⇔ Mega D19
   iv. Patch Brd M1,1 ⇔ Mega D18
   v. L298N ENA ⇔ Mega D4
   vi. L298N IN1 ⇔ Mega D22
   vii. L298N IN2 ⇔ Mega D23
   viii. L298N IN3 ⇔ Mega D24
   ix. L298N IN4 ⇔ Mega D25
   x. L298N ENB ⇔ Mega D5
   xi. Patch Brd +5v pin ⇔ Mega +5v header slot (see Schematic 4 above for available +5v source connectors on the Arduino Mega).

c) M/M - 20 cm. MPU-6050 to Mega (Qty: 4)
   i. MPU-6050 SDA ⇔ Mega D20
   ii. MPU-6050 SCL ⇔ Mega D21
   iii. MPU-6050 Vcc ⇔ Mega **+3.3v** header slot.
   xii. MPU-6050 GND ⇔ Mega GND header slot (see Schematic 4 above for available GND source connectors on the Arduino Mega).

d) RF Enable Switch connection to Mega.
   Connect:
   i. Switch's Red wire ⇔ Mega D12
   ii. Switch's Black wire ⇔ an open Mega GND header slot.

e) RF Receiver module connection to Mega (see Schematic 4 above).
   i. F/R-R (yellow wire) ⇔ Mega A0
   ii. F/R-F (blue wire) ⇔ Mega A1
   iii. L/R-R (green wire) ⇔ Mega A2
   iv. L/R-L (white wire) ⇔ Mega A3

10) Install first level acrylic shelf.

The spacers for the robot's two acrylic shelves can be installed in two different directions: a) threaded end facing up (away from base) where the top spacer, touching the top level, is F-F, or b) threaded end facing down (towards the base) where the spacer at the bottom, touching the base, is F-F. The diagram below shows the preferred alignment (a):

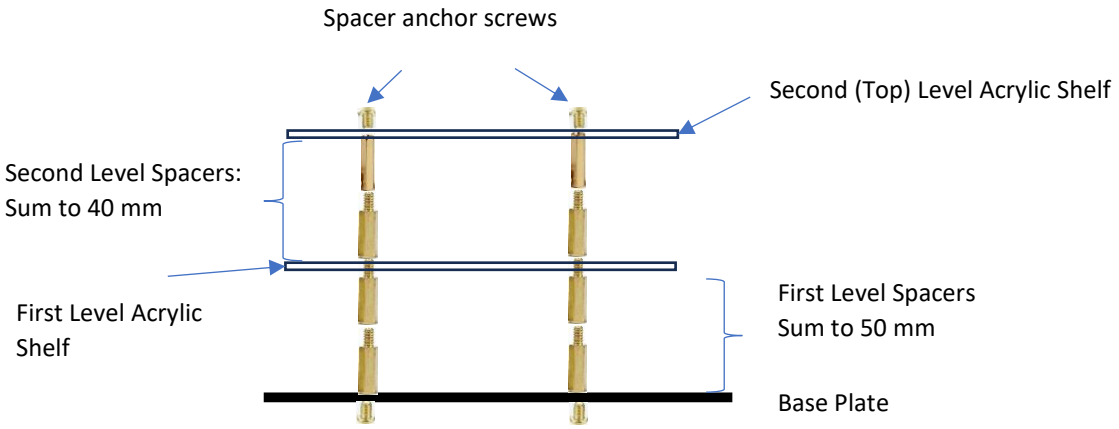


Figure: Displaying preferred spacer alignment.

11) Place components on 1st level shelf.
    a. Attach Raspberry Pi with velcro squares.
    b. Attach MPU-6050 and RF receiver with double sided tape.

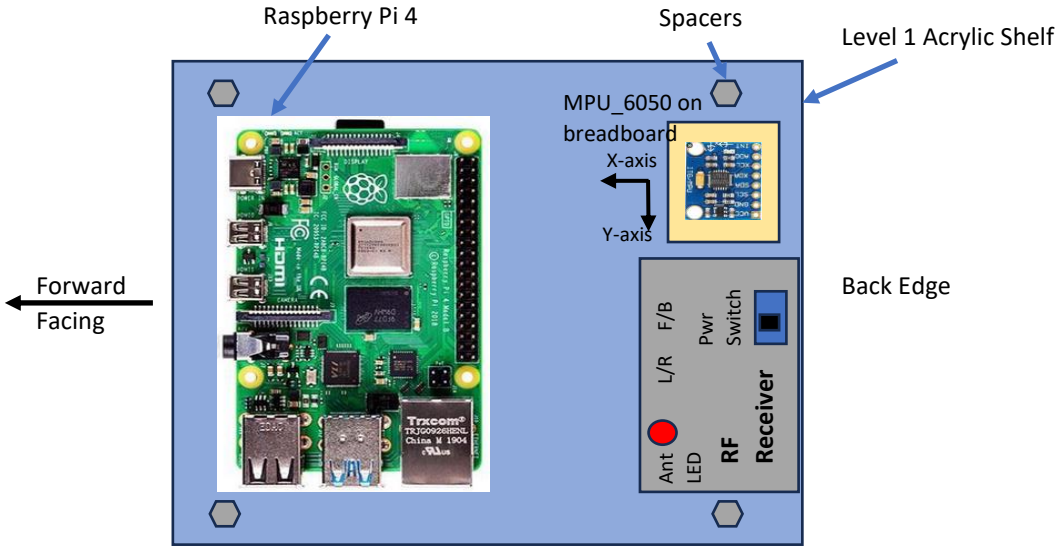


Figure. First Level Component Placement.

12) Install second level acrylic shelf (top).

Before you screw on the second level shelf, you need to attach the 2D lidar. The front legs of the lidar module are closer together than the rear legs.

To be finished shortly …

13) Install Raspberry Pi Camera and Plug in Cables

To be finished shortly …