

Queen's University
Department of Electrical & Computer Engineering
ELEC299 Q2WD Robot Project

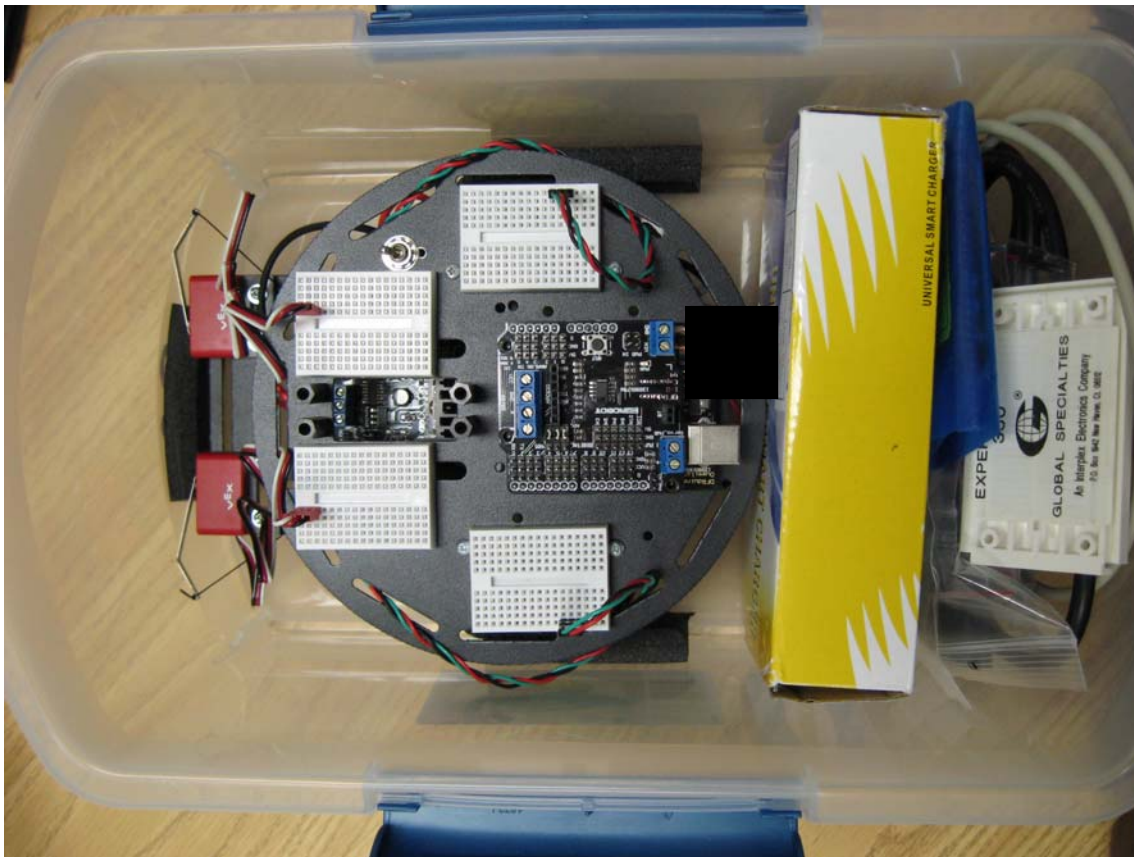
Bot Assembly

(more will be added to this as more robot parts are provided to you for assembly)



General Cautions and Advice

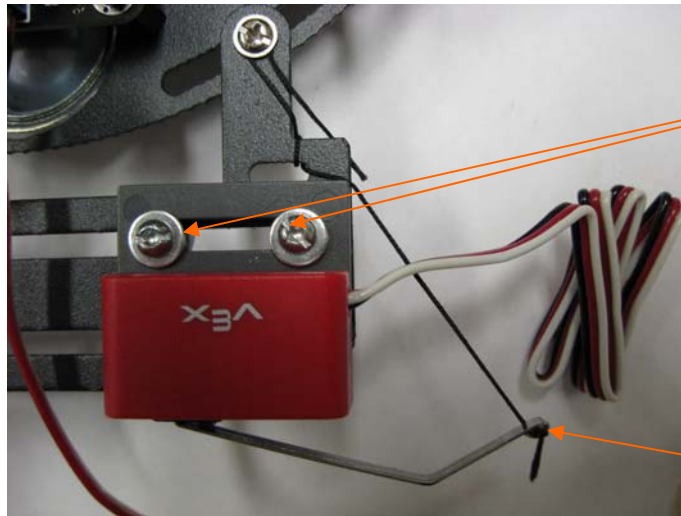
- 1) DO NOT overtighten any screws that thread into black or white nylon standoffs or parts– you will strip the nylon threads. Just tighten until snug, no further – that's all the force that is needed to assemble your Bot.
- 2) Only back off terminal block screws until flush with the top of the connector body else they might fall out and be lost. Check carefully that you have inserted the wire into the "jaws" of the connector, not the small space below it.
- 3) Check for loose/dangling wires before applying power.
- 4) When disconnecting connectors, always pull by the connector body, DO NOT PULL on the wires
- 5) Start keeping a notebook showing all your wiring connections for your robot.
- 6) Pack your kit carefully when done (no loose wires or possible snags – see photo below for preferred arrangement where the foam bumper (at either end of kit box) is used to protect bumper switches, and the foam bumpers at the sides restrict movement. Keep one of your battery packs inside the box with the charger, with the charger's power cable outside.



overhead
view into
kit box

Mounting the Bumper switches

- 1) Use four 3/8-inch long #4-40 screws (see screws in KitParts.pdf), with washers and nuts, as shown below.
- 2) Add black fishing line as some protection against accidentally snapping off the switch lever (this could happen as the Bot pivots or backs up near an obstacle, and also when /inserting removing your Bot from its kit box)
Insert unknotted end through lever tip, take one turn around the bracket as shown, adjust for proper length so that lever fully releases, then wrap the loose end underneath the bracket's panhead screw and retighten.



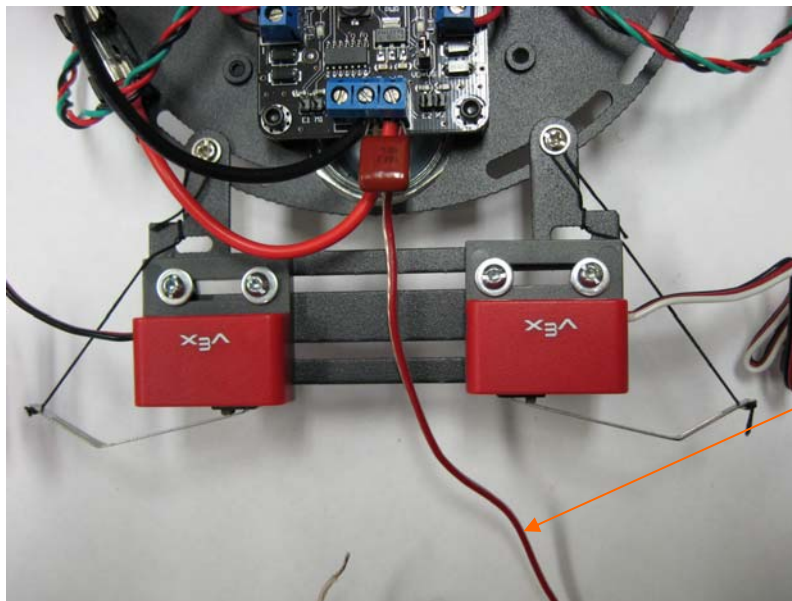
#4-40 machine screws, with #4 washers on top, and nuts below bracket

pass through with knotted end at top

Tapping Power from the Motor Controller Board

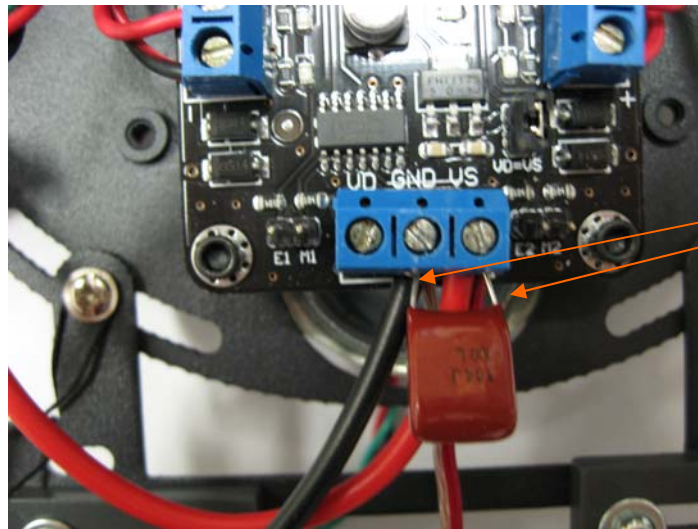
We will tap 6V input power for the Arduino microcontroller board on the top plate at the terminal block on the motor controller board.

- 1) Insert the "speaker" wire pair into power terminals as shown in photo below, with its thin leads placed in the terminal connector jaws alongside the larger power leads coming from the battery pack.



speaker wire pair (RED wire on right)

- 2) Add a brown capacitor (zoomed-in photo below) to take up extra wire space for a tight connection (the capacitor has no real electrical function here – it's just to allow a better mechanical grip on the skinnier speaker wires). The RED-striped wire of the pair goes into the rightmost terminal with the RED power wire coming from the fuse. DO NOT try to strip more off the wires and attempt to twist the wires together.

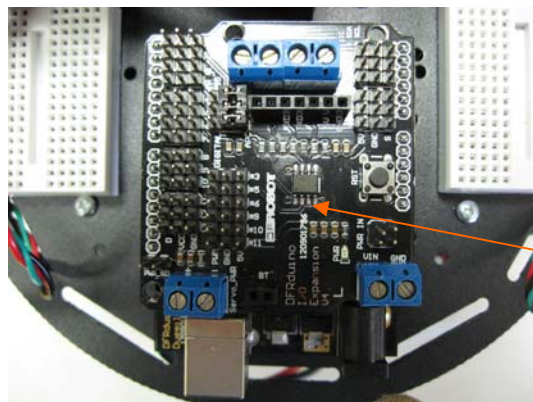


capacitor's leads sit on TOP of the skinny speaker wire leads to take up space

Plugging in the I/O Expansion board

The top plate holds the Arduino microcontroller (clone) board. The I/O expansion board will plug into the top of the Arduino clone. The I/O expansion board has convenient male pin groupings for connecting the 3-wire servo cables (for later), and for using female cables and single prefabricated wires to connect to the Arduino pin signals (which are brought up from the pins below). We will feed power through the I/O expansion board down to the VIN input of the Arduino clone with +6V (VIN is regulated onboard the Arduino down to 5V).

To plug in the I/O Expansion board on top of the Arduino clone board, first line up the I/O board pins carefully with the female socket row connectors on the Arduino board below (on some boards these may be a bit tipped so you may need to squeeze or push them over as you are inserting).

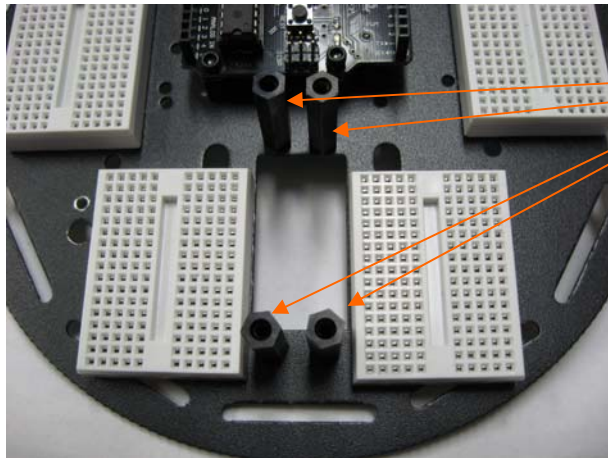


DFRobot I/O expansion board mounted on top of Arduino board

Mounting the Top Plate

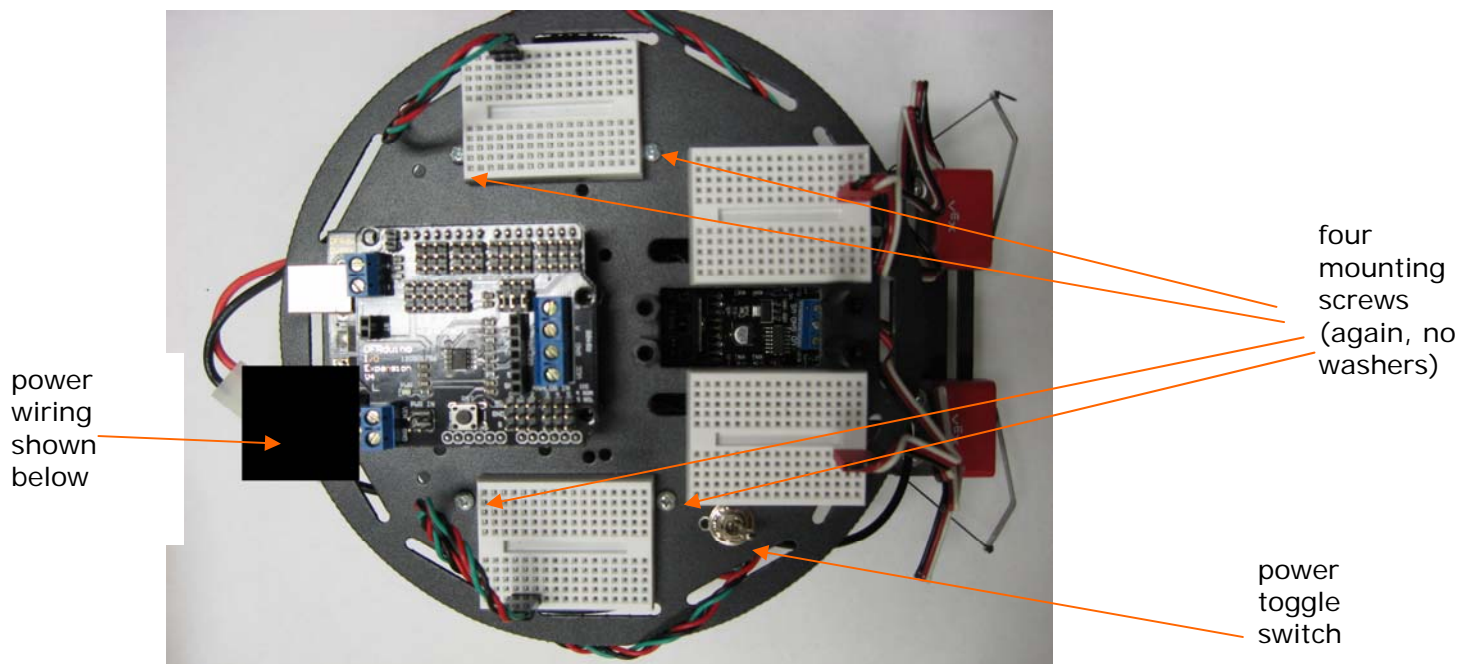
Before mounting the top plate:

- 1) Using four #4-40 ¼-inch machine screws from below the top plate (we will not use washers), install four 1-inch black nylon standoffs for the servo (to be installed later) – keep the front standoffs spaced as far as possible --there is some wiggle room before you tighten the screws. **DO NOT OVERTIGHTEN.**



Mounting the top plate:

- 1) Make sure the power switch harness is routed **inside** the Bot side brackets and the battery connector comes out at the back right.
- 2) Position the top plate so that the four mounting holes are aligned with the standoffs already installed on the Bot side brackets underneath. You may need to flex the Bot side brackets in a bit to get lined up with the standoff holes.
- 3) Insert four #4-40 ¼-inch machine screws into the standoffs and tighten until snug. **DO NOT OVERTIGHTEN.**



Install Power Switch after mounting the top plate:

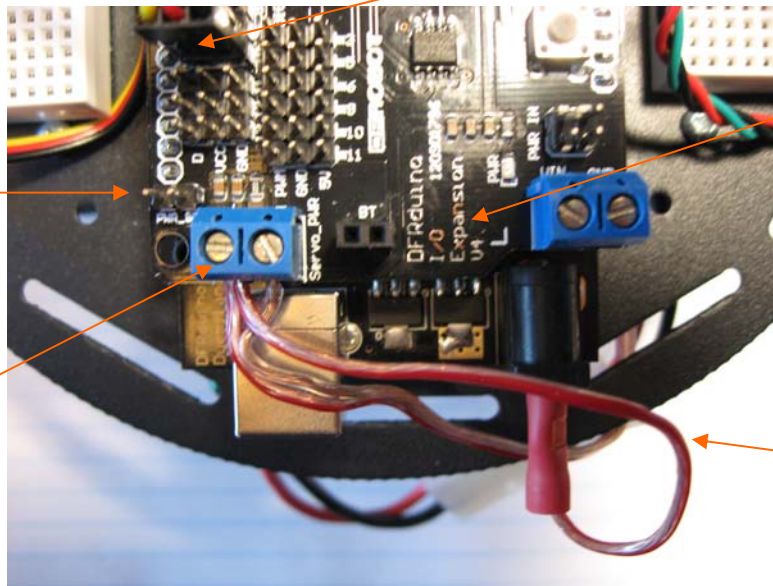
- 1) Remove the top nut, toothed lock washer, and large plate washer from the neck of the red power toggle switch – leave the lower nut on and hand tighten it down
- 2) Push the power toggle switch through the existing hole in the top plate located approximately above the fuse – note there is a slim slot at the back of the switch's threaded neck (this should go toward the **back** of the Bot). The large plate washer is keyed to the slot, and has a tab that goes into the smaller predrilled hole just behind the main switch hole -- this prevents switch rotation when tightening. The toothed lock washer goes on top of this plate washer, followed by the top nut – hand tighten for now if you have not yet bought your tool kit (which contains needle-nose pliers).

Rerouting Wiring

- 1) Reroute your power wiring as shown in the photo below.

MAKE sure NO jumper is on the PWR_SEL pins (it would short +5V to our battery input!)

speaker wire pair inserted here after mounting the top plate (RED wire on left)



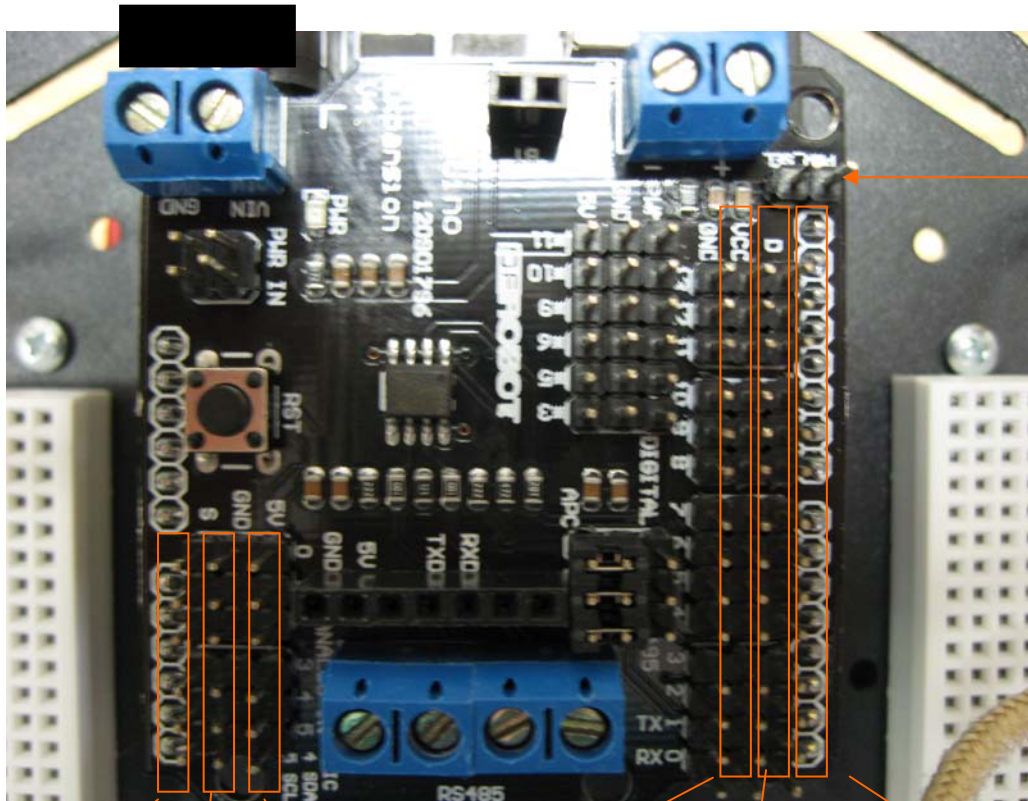
future servo –
cable connection

I/O expansion
board mounted
on top of
Arduino clone

pigtail supplies
battery power
to Arduino
power plug
(insert until
fully seated)

- 2) Reroute your E1,M1, E2, M2 connections between the I/O expansion board and the motor controller board using FEMALE-FEMALE red/black 2-wire cables. This is conveniently done if you choose adjacent pins for each motors Ex,Mx signals – I suggest you use digital pin pairs (4,5) and (6,7) for this purpose as we will need higher numbered pins for the servo motors (5 and 6 are the PWM pins for E1 and E2).

--SEE I/O board pin locations in photo below (DO NOT USE PINS 0 or 1 as they are reserved for USB serial port communications)



MAKE sure NO jumper is on the PWR_SEL pins (it would short +5V to our battery input!)

analog pins 0-5 on outside row (S = signal)

all GND pins on middle row

all +5V pins on inner row

all GND pins on inside row

all VCC pins on middle row (+6V after connecting battery power to the terminal block just above -- **DO NOT connect anything needing 5V to these pins, as 6V is too much!**)

digital pins 0-13 on outside row (D = data but **pins 0 and 1 are reserved for USB serial communications**)

- 3) Reroute your motor encoder cables through the slots on the top plate to keep them manageable (as in the photos above). **DO NOT** be tempted to plug them directly in to the "convenient" 3-pin group available on the I/O board – that would feed battery voltage VCC (up to 6.5V) to the encoders (which exceeds their rating of +5V, and passes a logic HIGH of almost the same voltage into the ATmega pin, which exceeds its rating – **either one could burn out**). You must still route them into your bimbards and supply them with +5V and GND from there.
- 4) Route your bumper switch cables up through slots on the top plate and into your protoboards on the left and right sides. You'll need to add resistors to create a "pushbutton-style" circuit.