

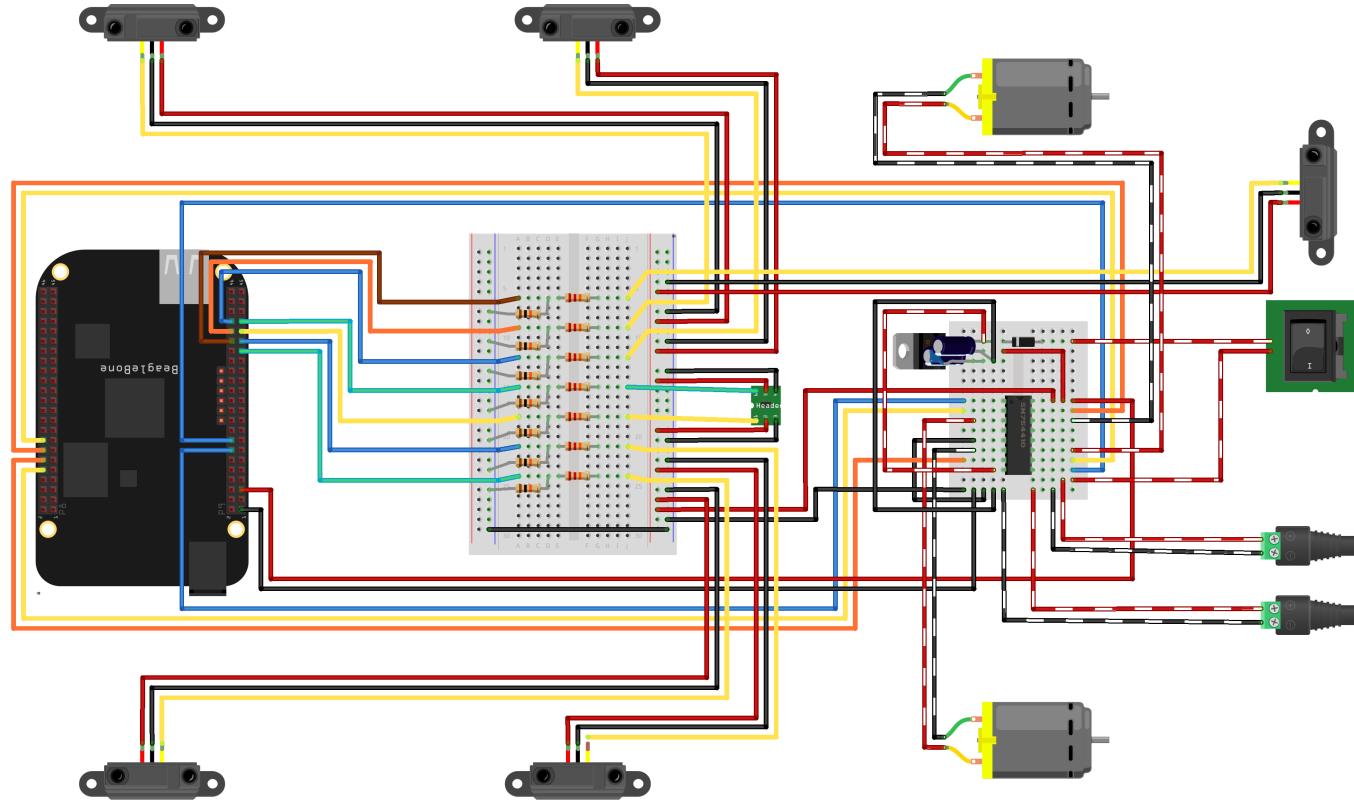
Wiring the QuickBot

Control of Mobile Robots: Hardware Lecture #3



Rowland O'Flaherty
Robotics Ph.D. Candidate
Georgia Tech

QuickBot Wiring



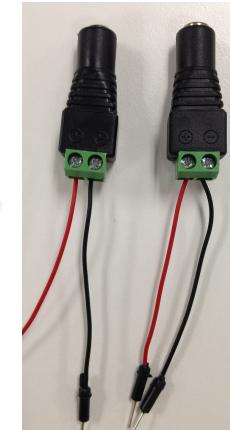
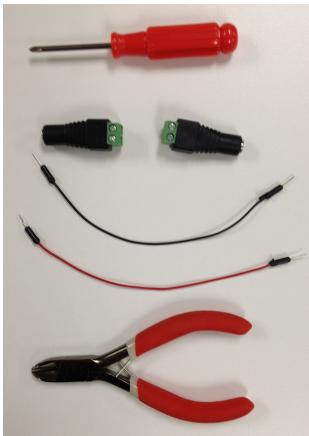
fritzing

QuickBot Parts



Build DC Barrel Plug Connectors

- Cut 2 M-M jumper wires and strip ends

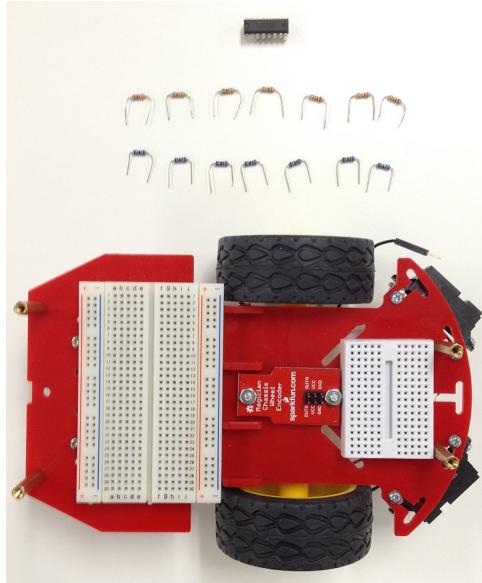


Red wire into "+" pole
Black wire into "-" pole

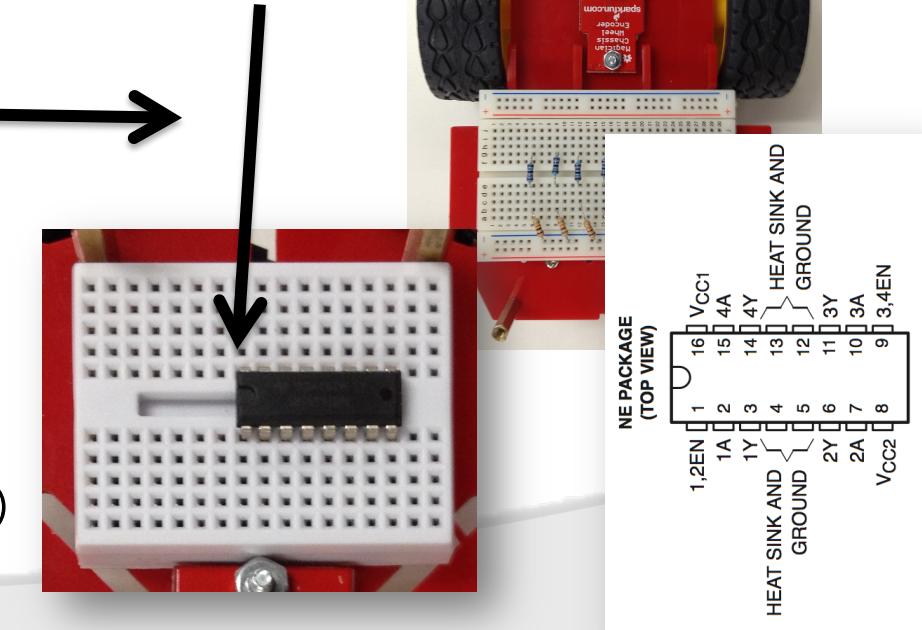


- Two DC Barrel Jacks
- One Black M/M Wire
- One Read M/M Wire

Add H-Bridge and Voltage Divider Resistors

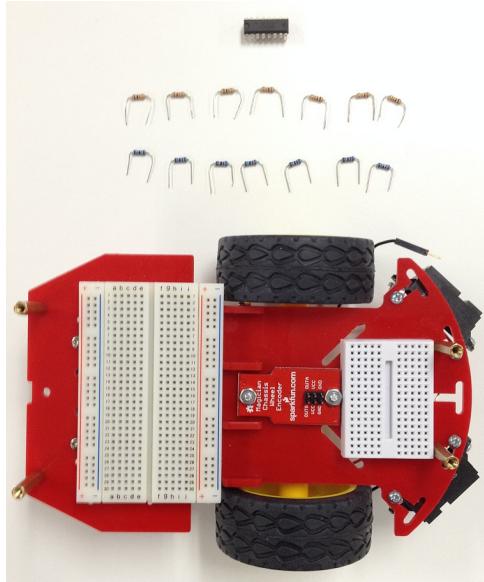


Place notch on IC to the left



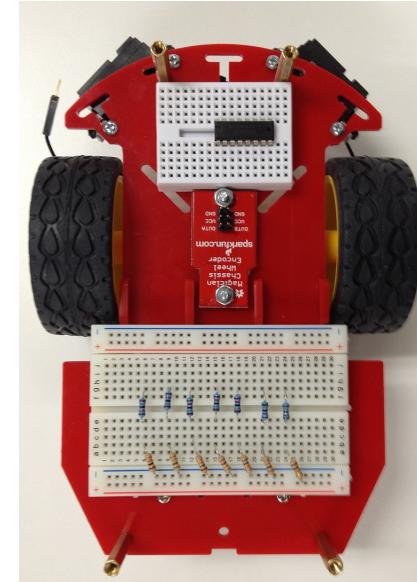
- H-Bridge IC
- Seven 20K Resistors (Red, Black, Orange)
- Seven 10K Resistors (Brown, Black, Orange)

Add H-Bridge and Voltage Divider Resistors



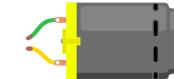
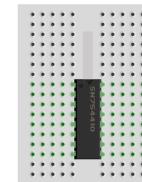
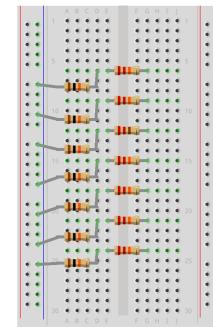
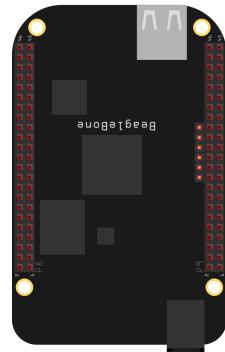
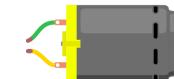
For the voltage divider
use breadboard rows:

1. Row 6
2. Row 9
3. Row 12
4. Row 15
5. Row 18
6. Row 21
7. Row 24

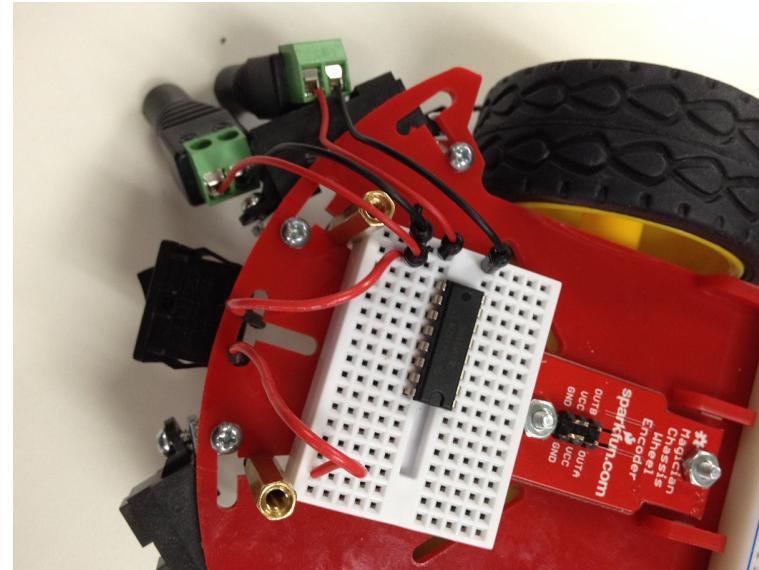
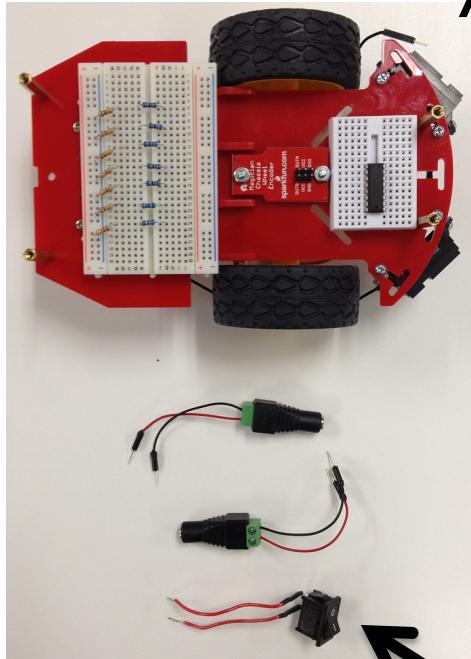


- H-Bridge IC
- Seven 20K Resistors (Red, Black, Orange)
- Seven 10K Resistors (Brown, Black, Orange)

Add H-Bridge and Voltage Divider Resistors



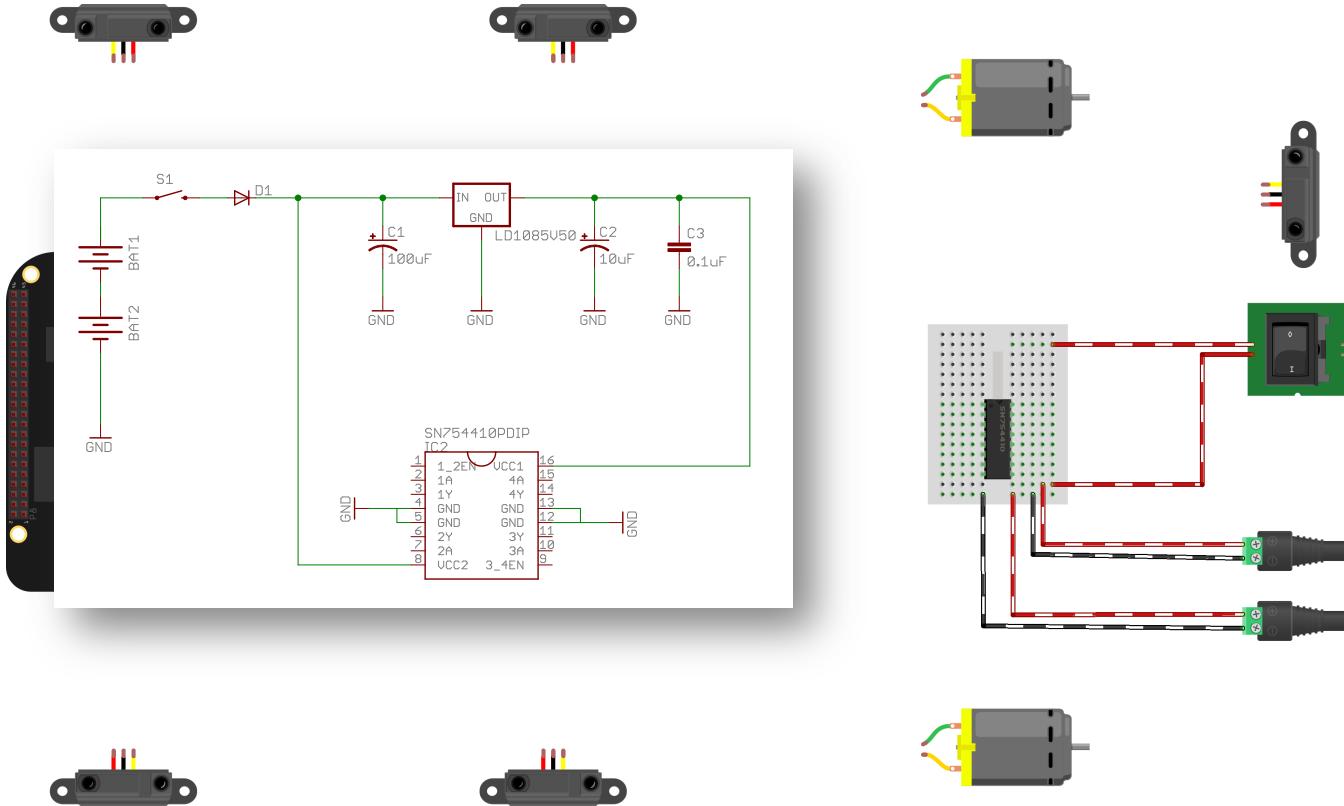
Add DC Jacks & Switch



- Two DC Jacks
- Switch

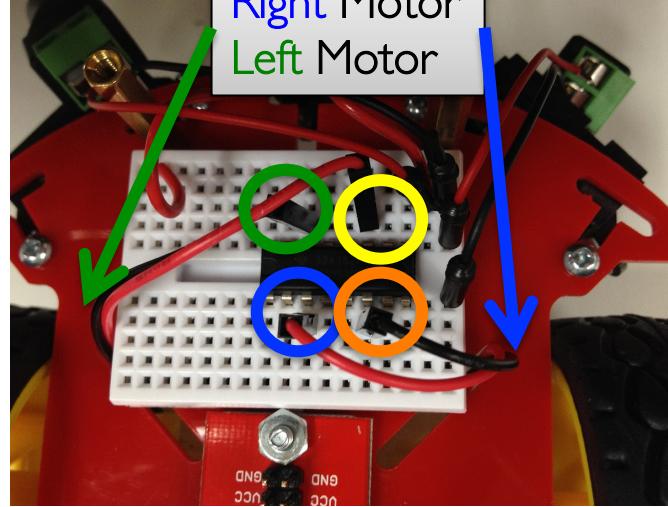
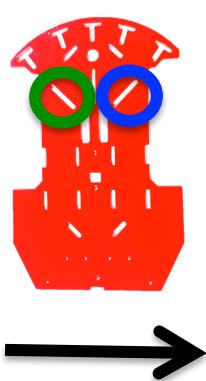
Requires soldering

Add DC Jacks & Switch



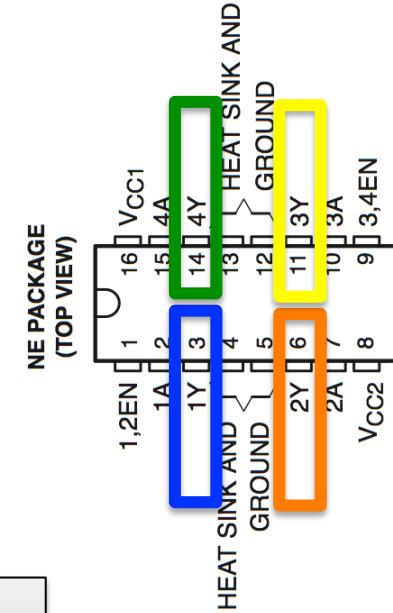
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Plug In Motor Wires

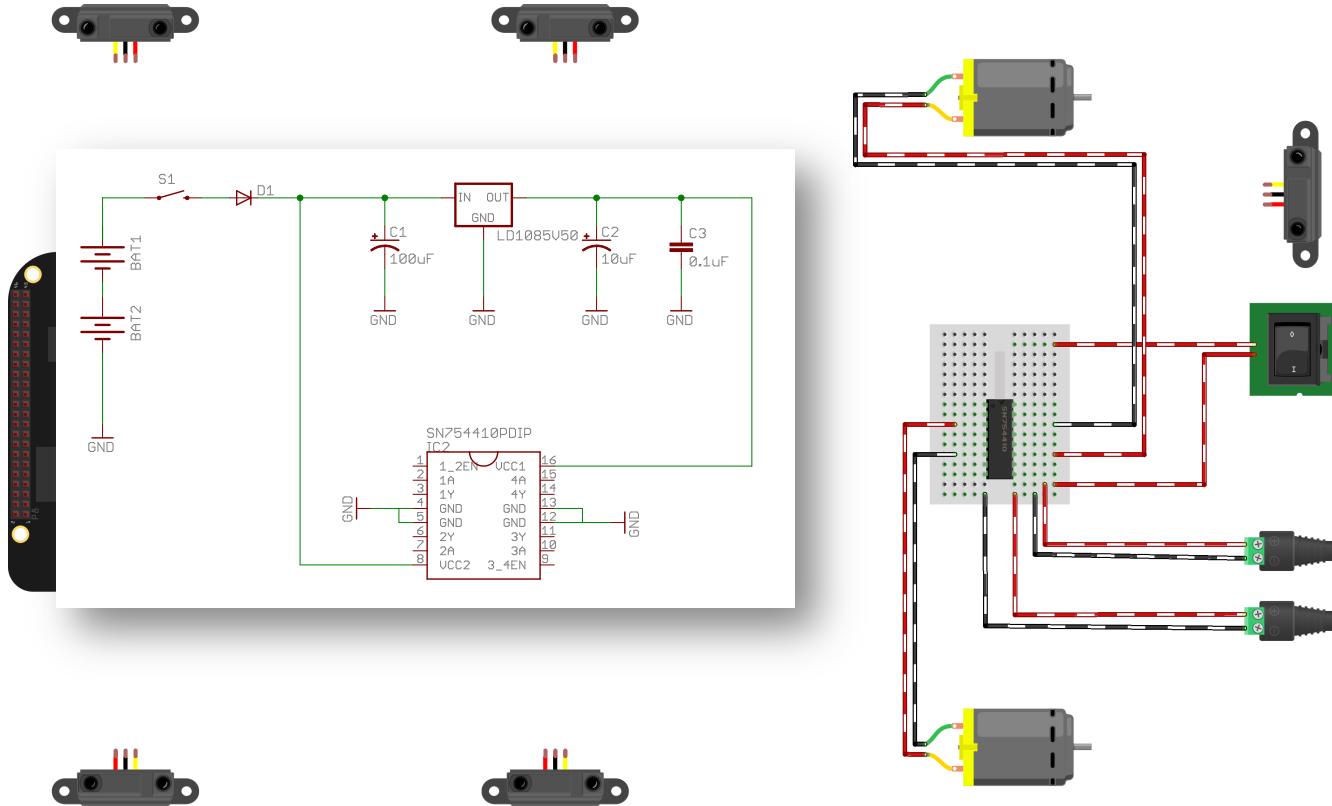


Tape wires

- Connect Right Motor Red Wire to H-Bridge 1Y (Pin 3)
- Connect Right Motor Black Wire to H-Bridge 2Y (Pin 6)
- Connect Left Motor Red Wire to H-Bridge 3Y (Pin 11)
- Connect Left Motor Black Wire to H-Bridge 4Y (Pin 14)

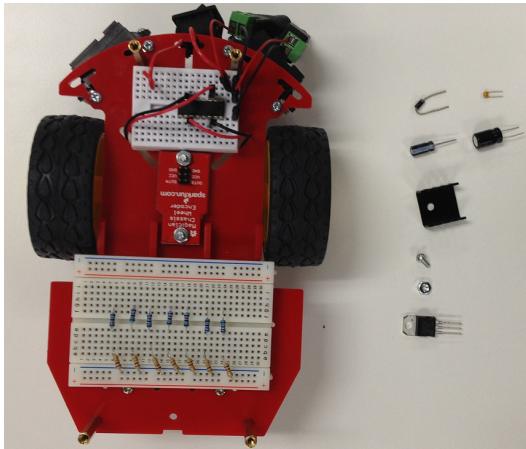


Plug In Motor Wires



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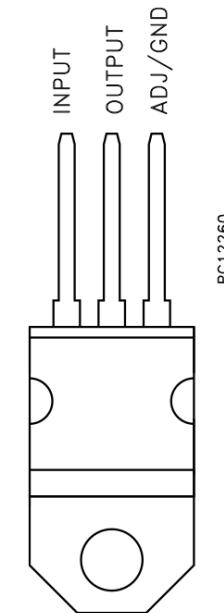
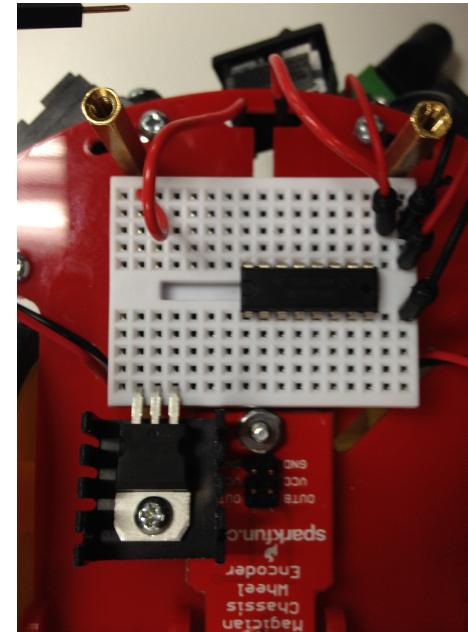
Assemble Power Supply – Voltage Regulator



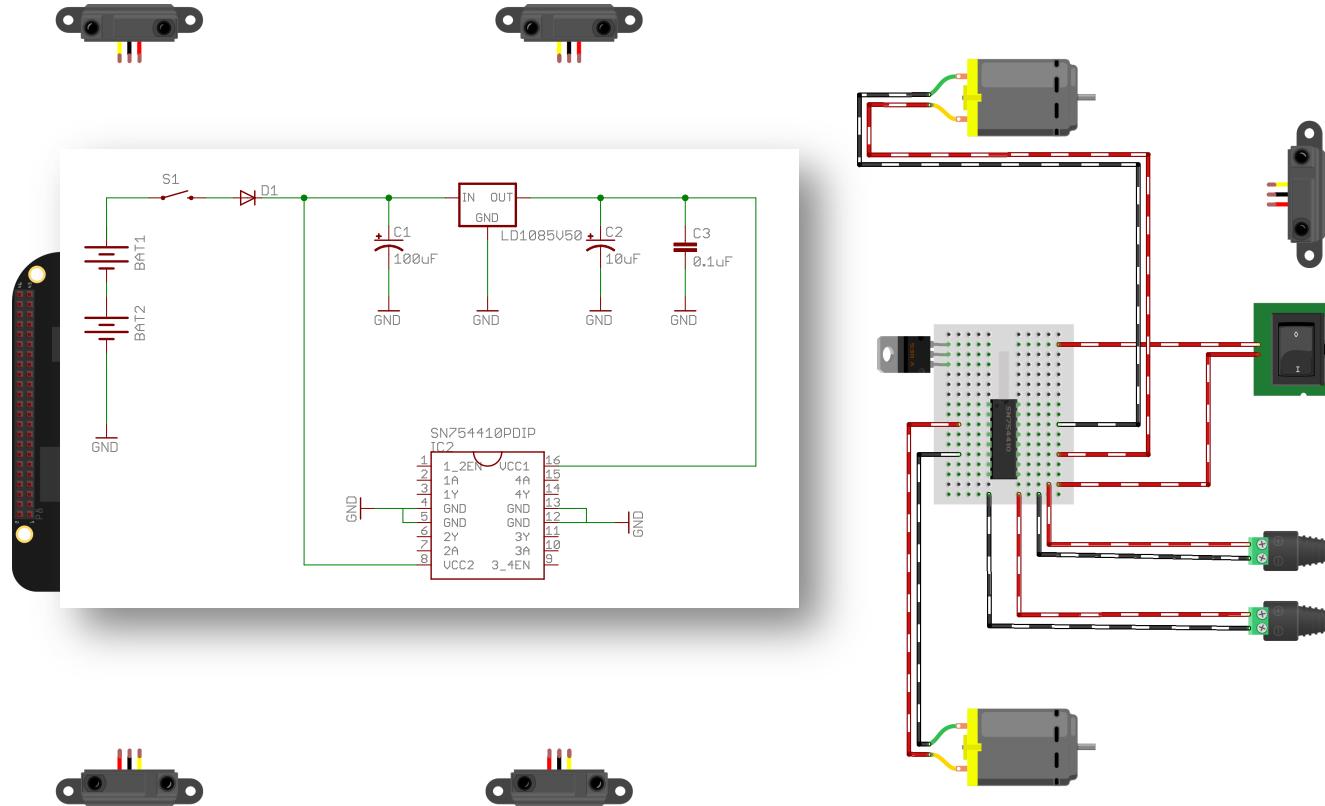
Start with
voltage regulator



- One Voltage Regulator
- One $\frac{1}{4}$ " 4-40 Screws
- One 4-40 Angle Bracket
- One Heat Sink
- One 100uF Capacitor
- One 10uF Capacitor
- One 0.1uF Capacitor
- One Diode

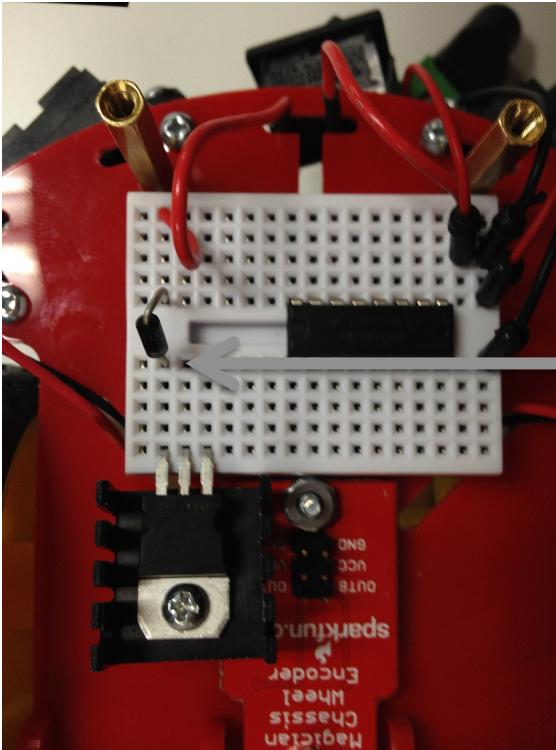


Assemble Power Supply – Voltage Regulator

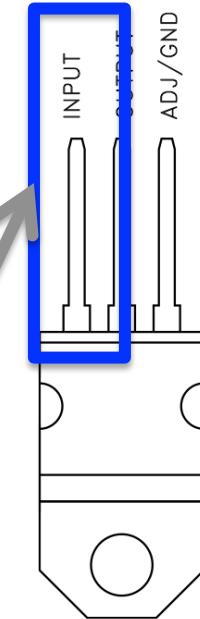


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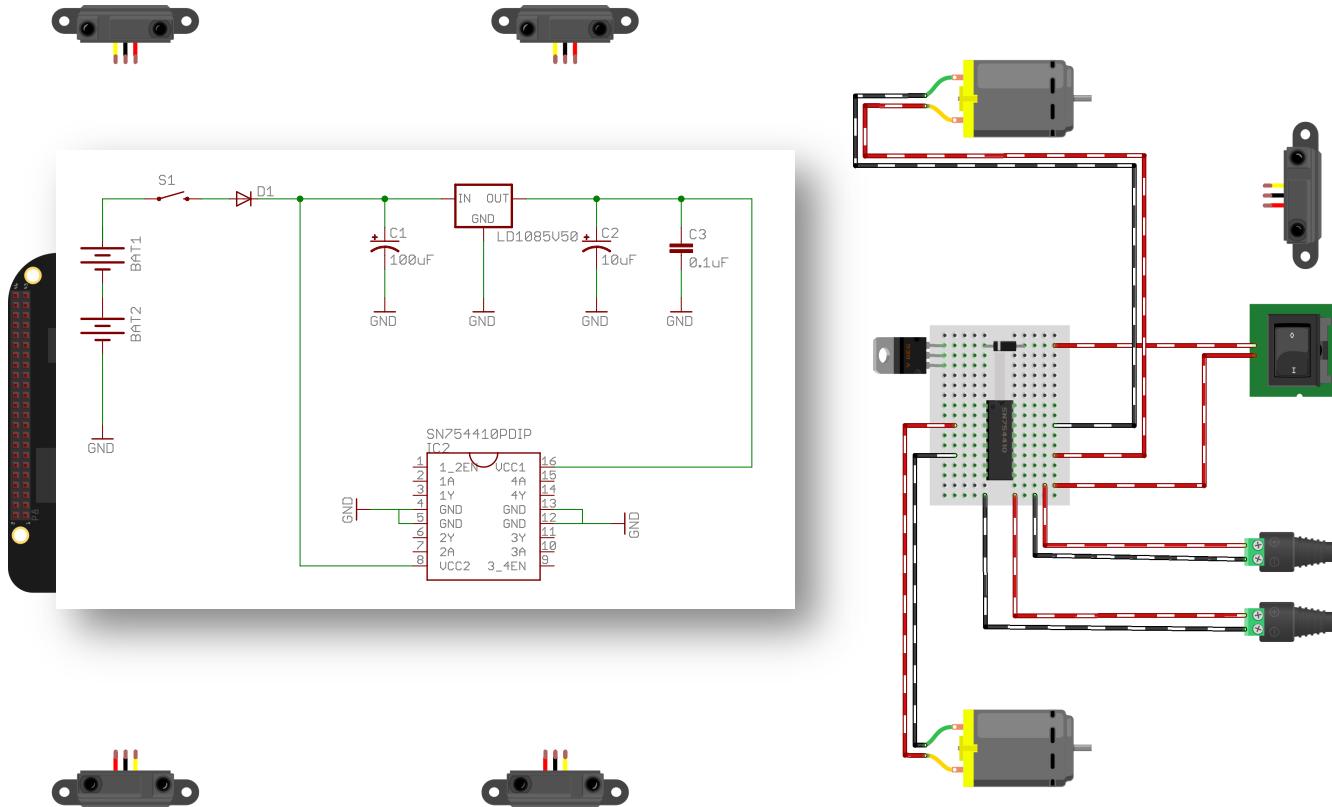
Assemble Power Supply – Diode



- Diode lead with LINE connect to **voltage regulator INPUT pin**
- Diode lead without LINE connect switch

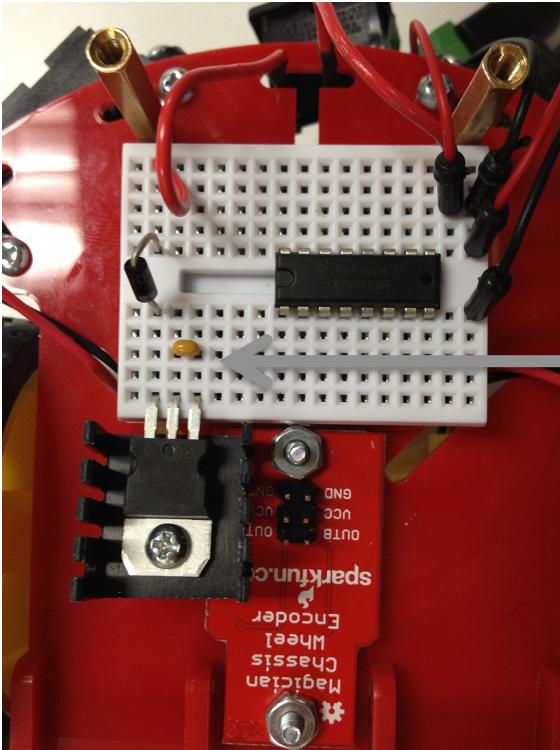


Assemble Power Supply – Diode

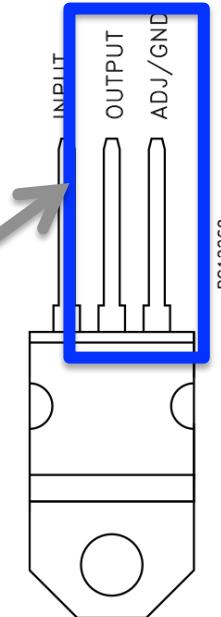


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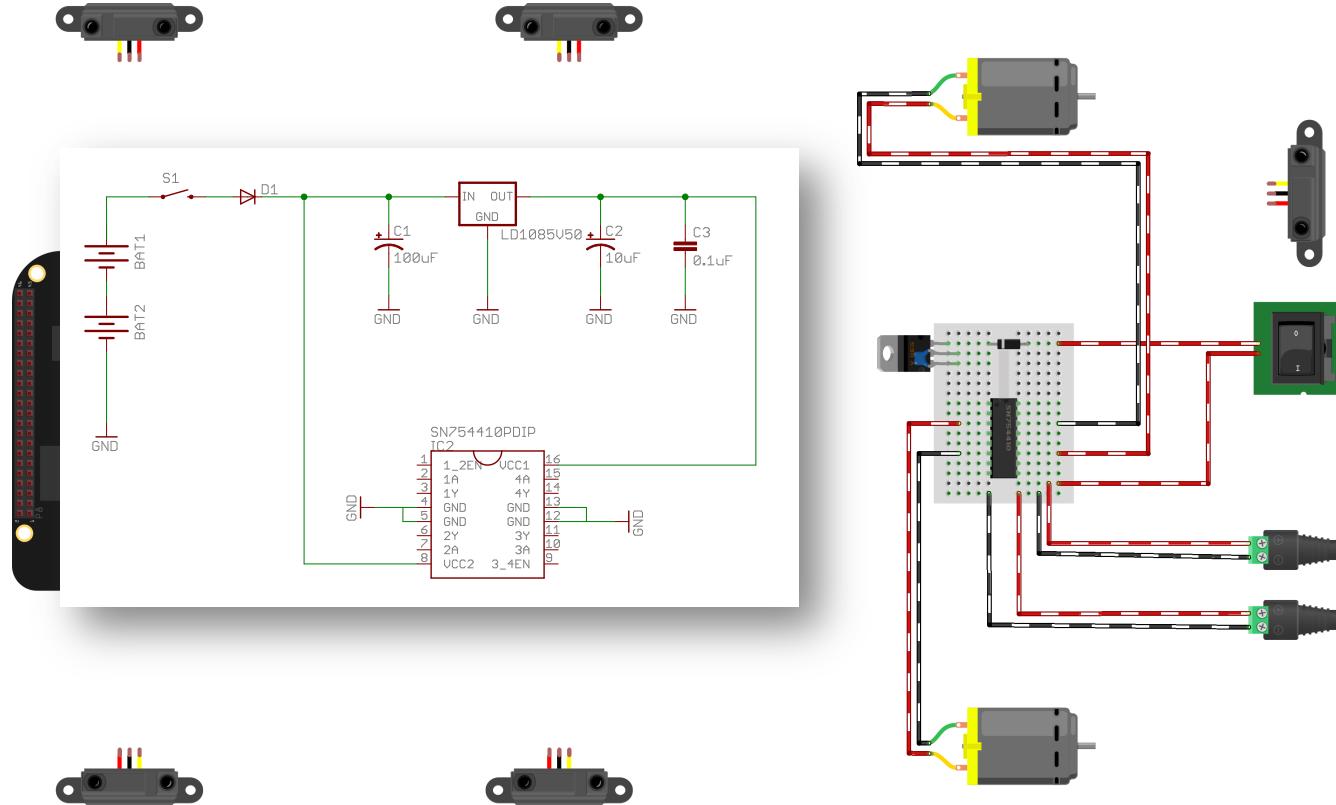
Assemble Power Supply – 0.1 uF Cap



0.1uF Cap connect to
voltage regulator **OUTPUT**
and **GND**

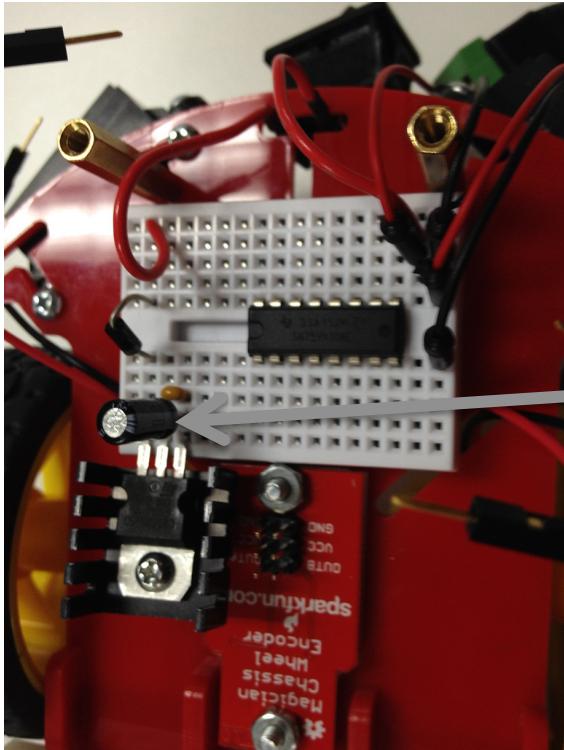


Assemble Power Supply – 0.1 uF Cap

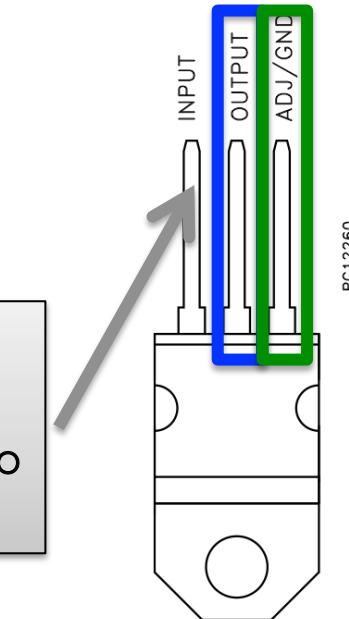


Made with Fritzing.org

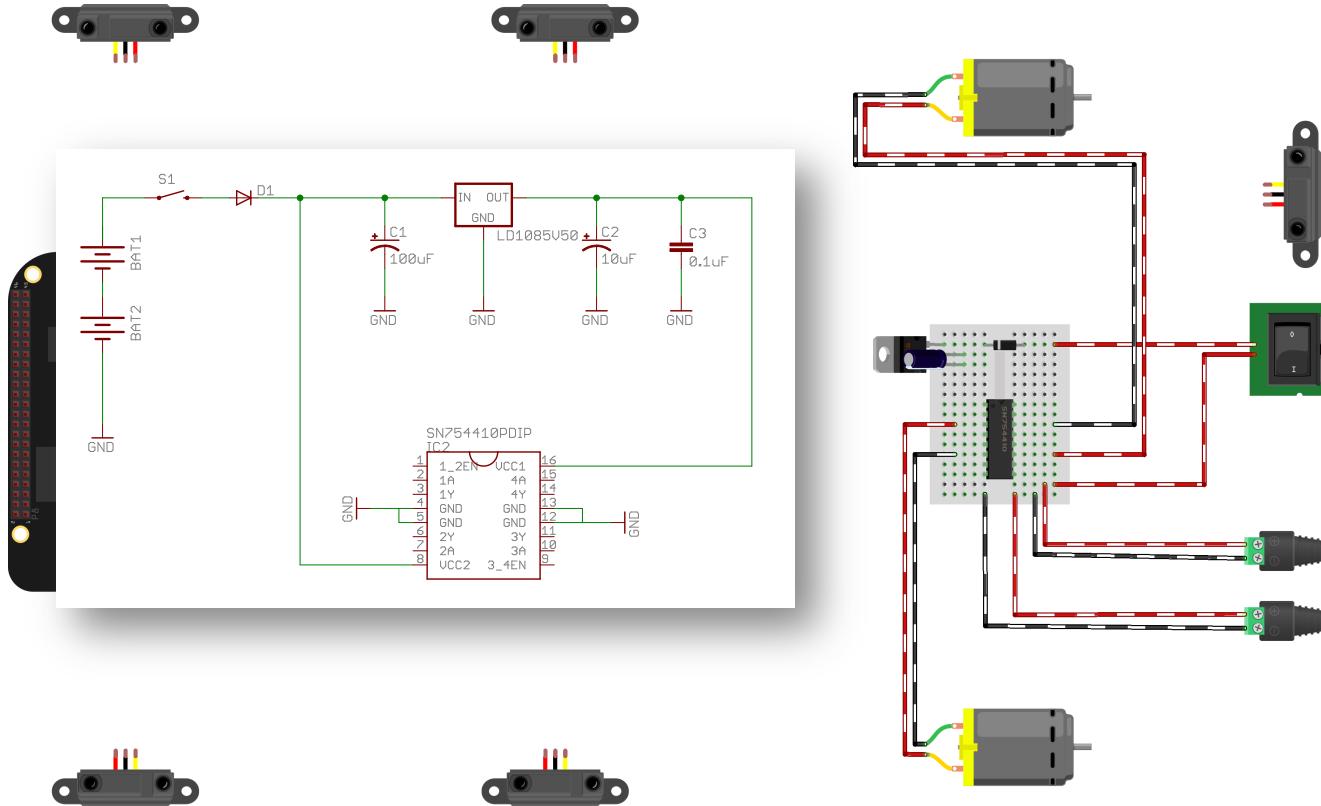
Assemble Power Supply – 10uF Cap



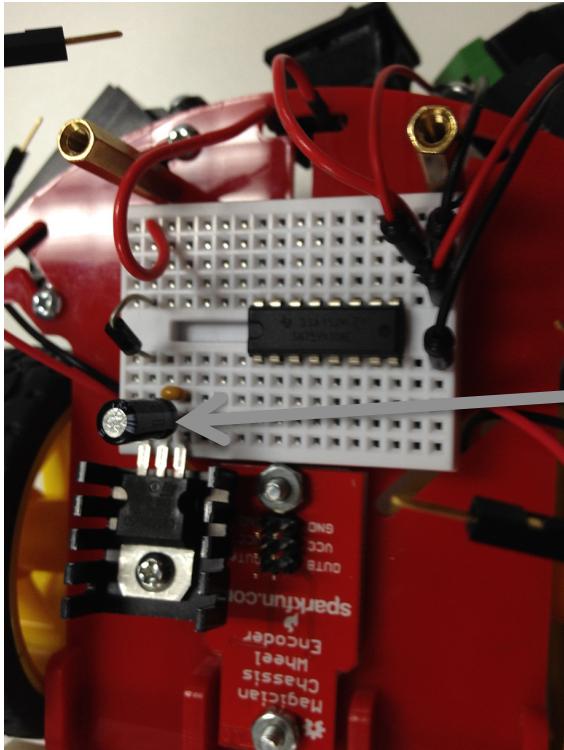
- 10uF Cap positive lead connect to **voltage regulator OUTPUT pin**
- 10uF Cap negative lead ("−") connect to **voltage regulator GND pin**



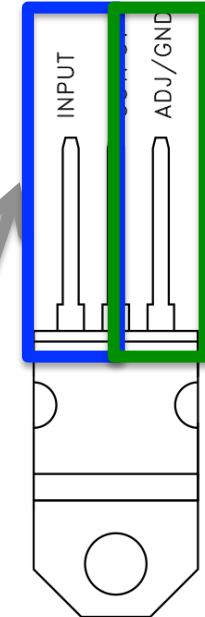
Assemble Power Supply – 100uF Cap



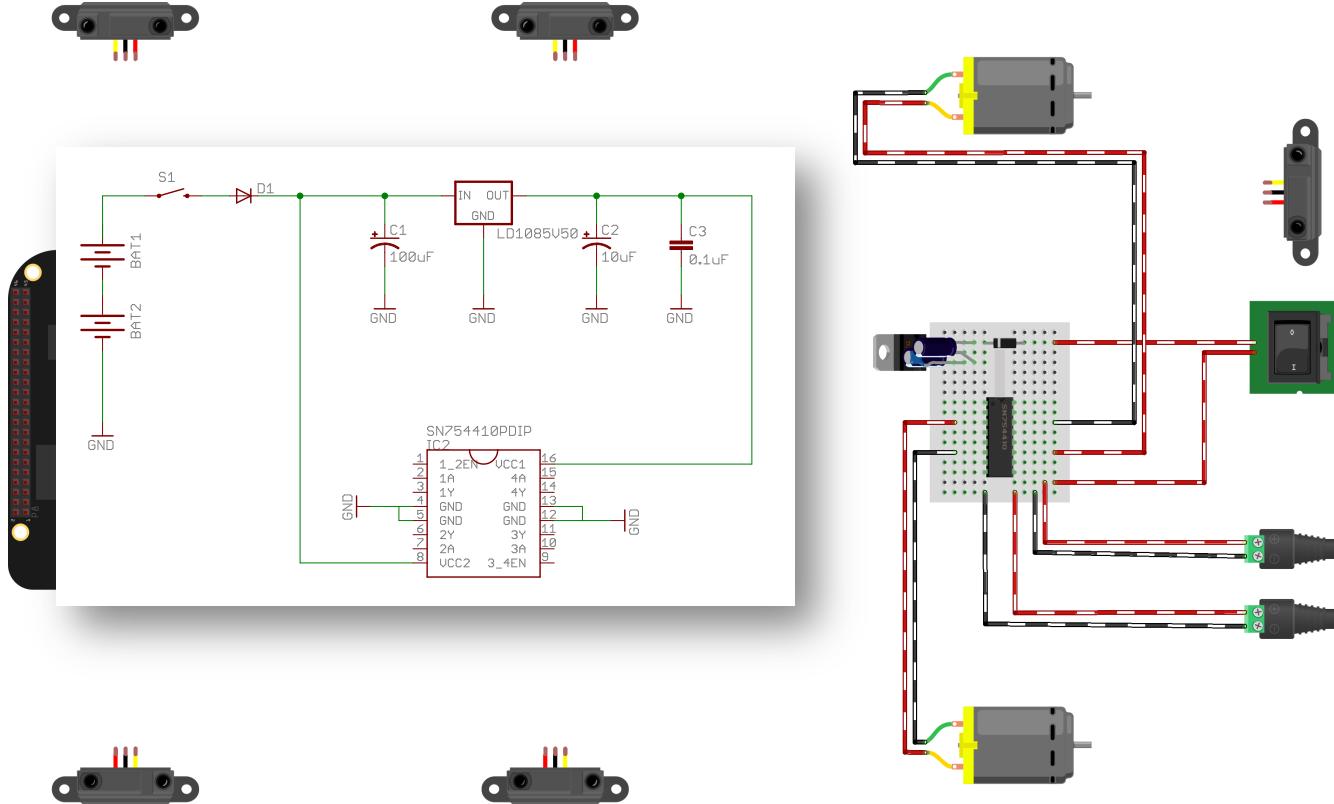
Assemble Power Supply – 100uF Cap



- 100uF Cap positive lead connect to **voltage regulator INPUT pin**
- 100uF Cap negative lead ("−") connect to **voltage regulator GND pin**

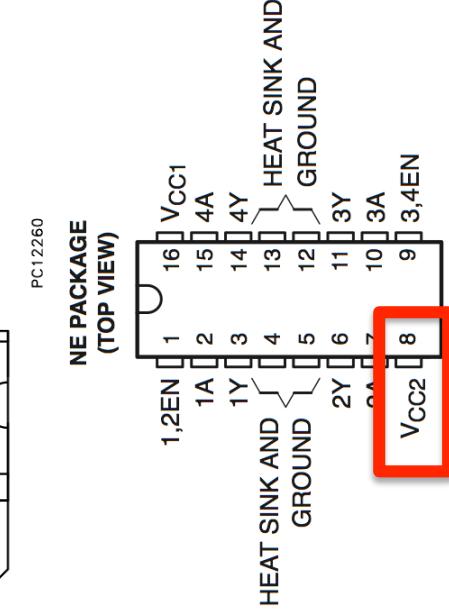
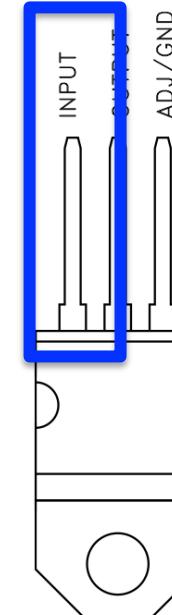
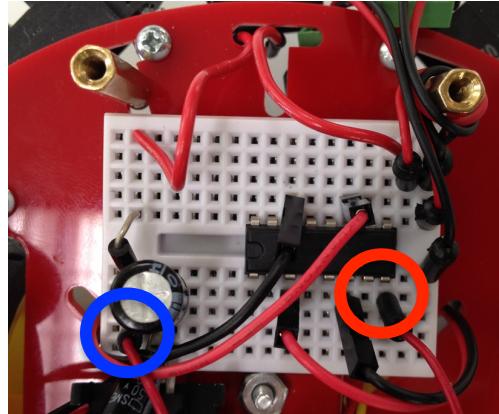
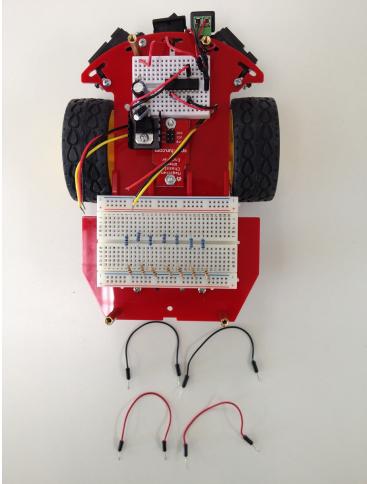


Assemble Power Supply – 100uF Cap



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Connect H-Bridge Power – 1st Red Wire

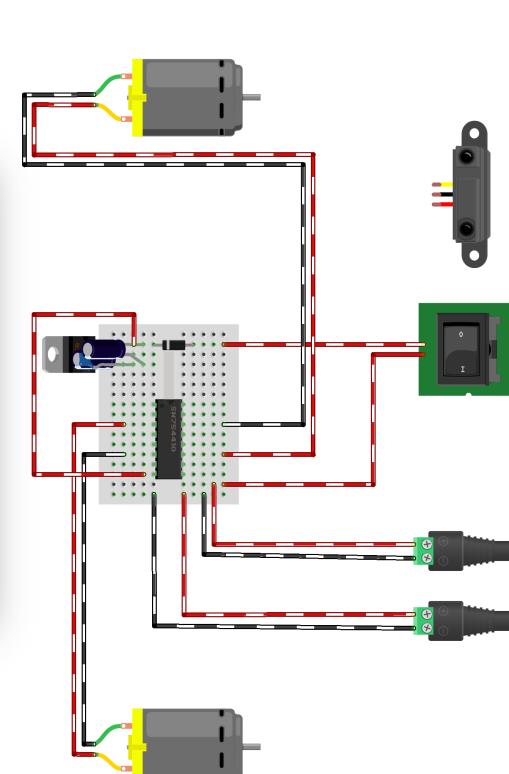
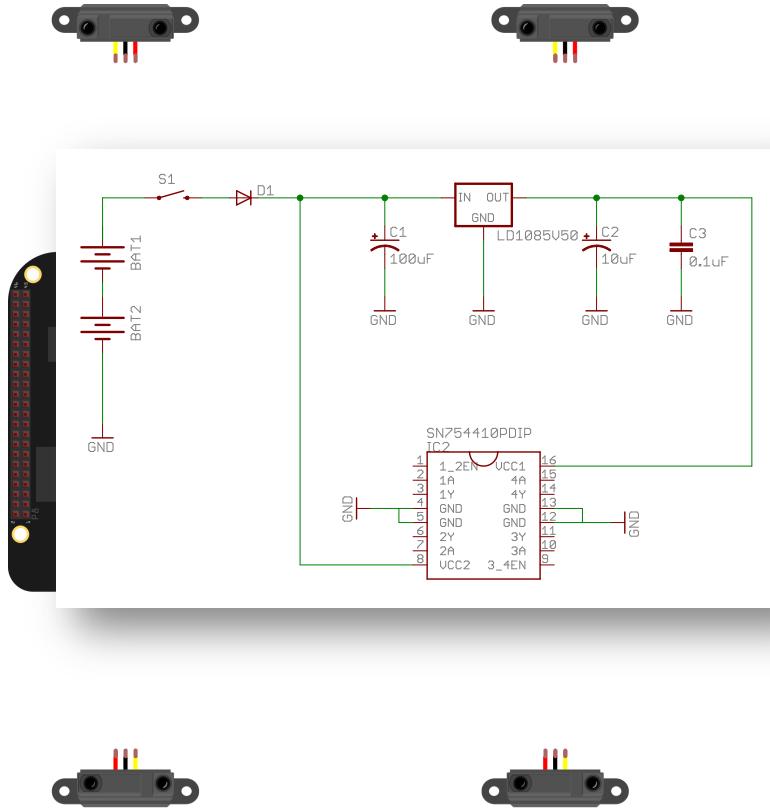


- Two Black M/M Wires
- Two Red M/M Wires

Connect **voltage regulator INPUT** pin to **H-Bridge Vcc2 (Pin 8)**

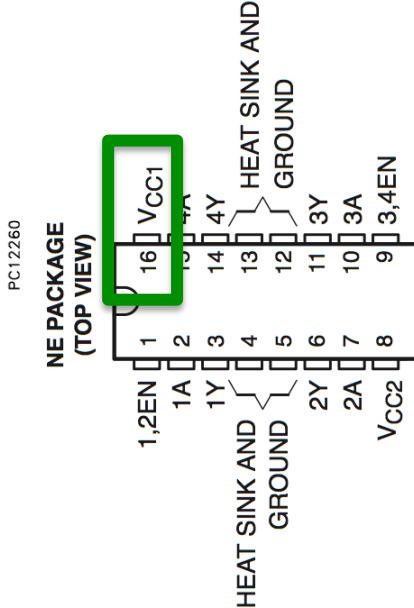
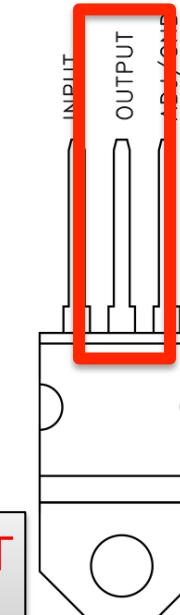
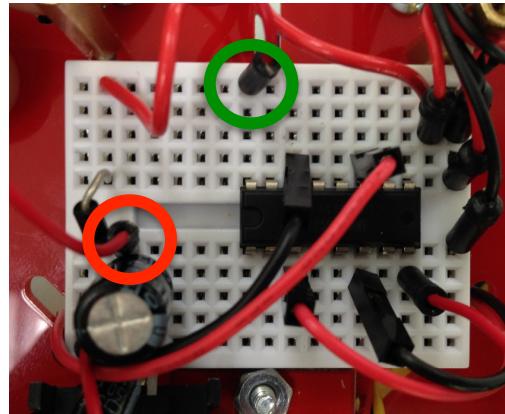
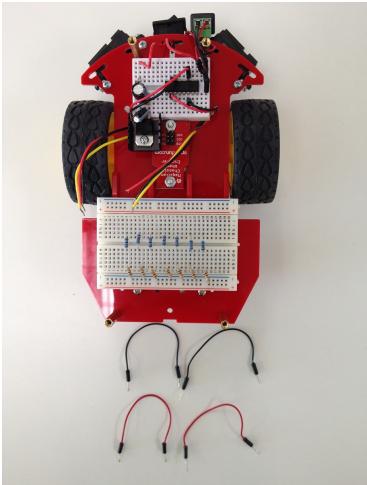
Caution: Triple check that you have wired this connection correctly.
If this is wired incorrectly there is a good chance you will burn out your BeagleBone Black!

Connect H-Bridge Power – 1st Red Wire



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Connect H-Bridge Power – 2nd Red Wire

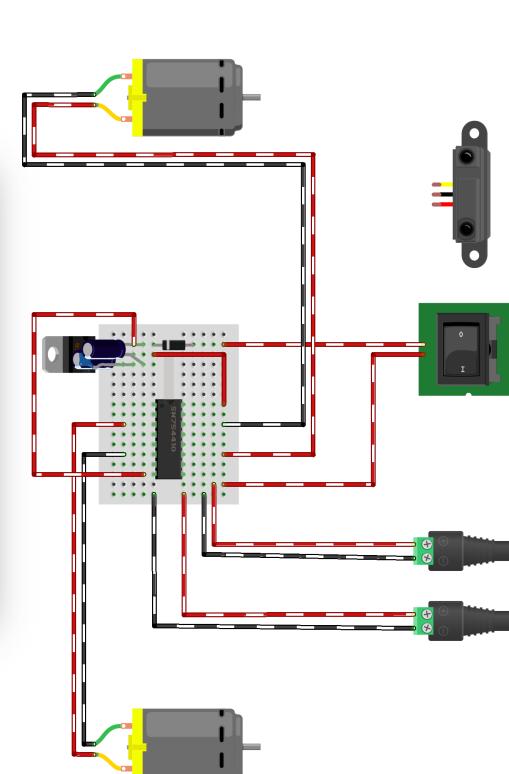
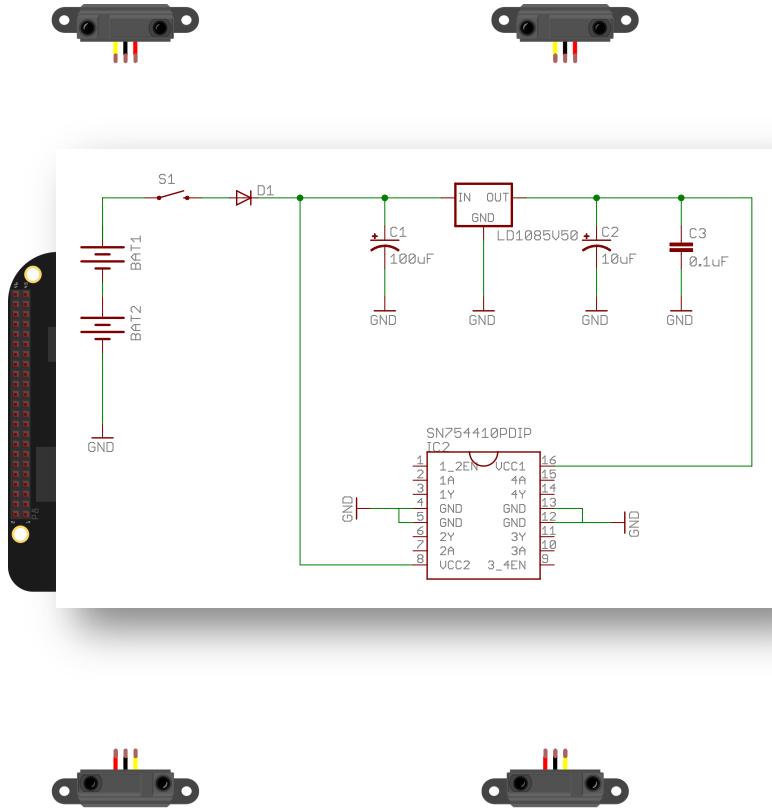


- Two Black M/M Wires
- Two Red M/M Wires

Connect **voltage regulator OUTPUT pin** to **H-Bridge Vcc1 (Pin 16)**

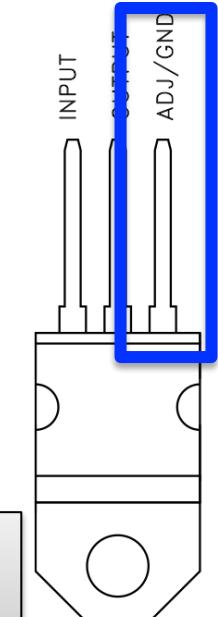
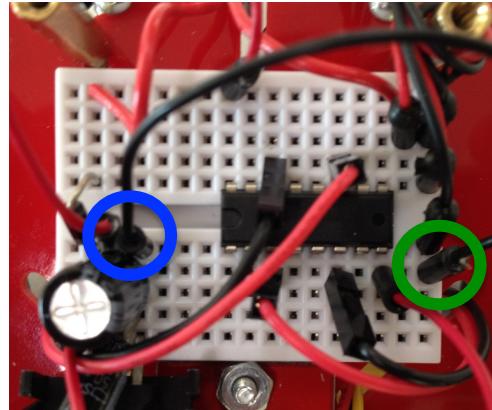
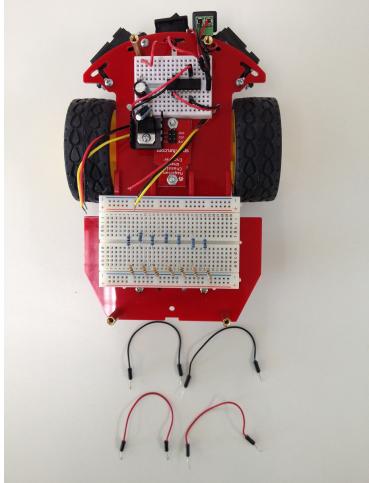
Caution: Triple check that you have wired this connection correctly.
If this is wired incorrectly there is a good chance you will burn out your BeagleBone Black!

Connect H-Bridge Power – 2nd Red Wire



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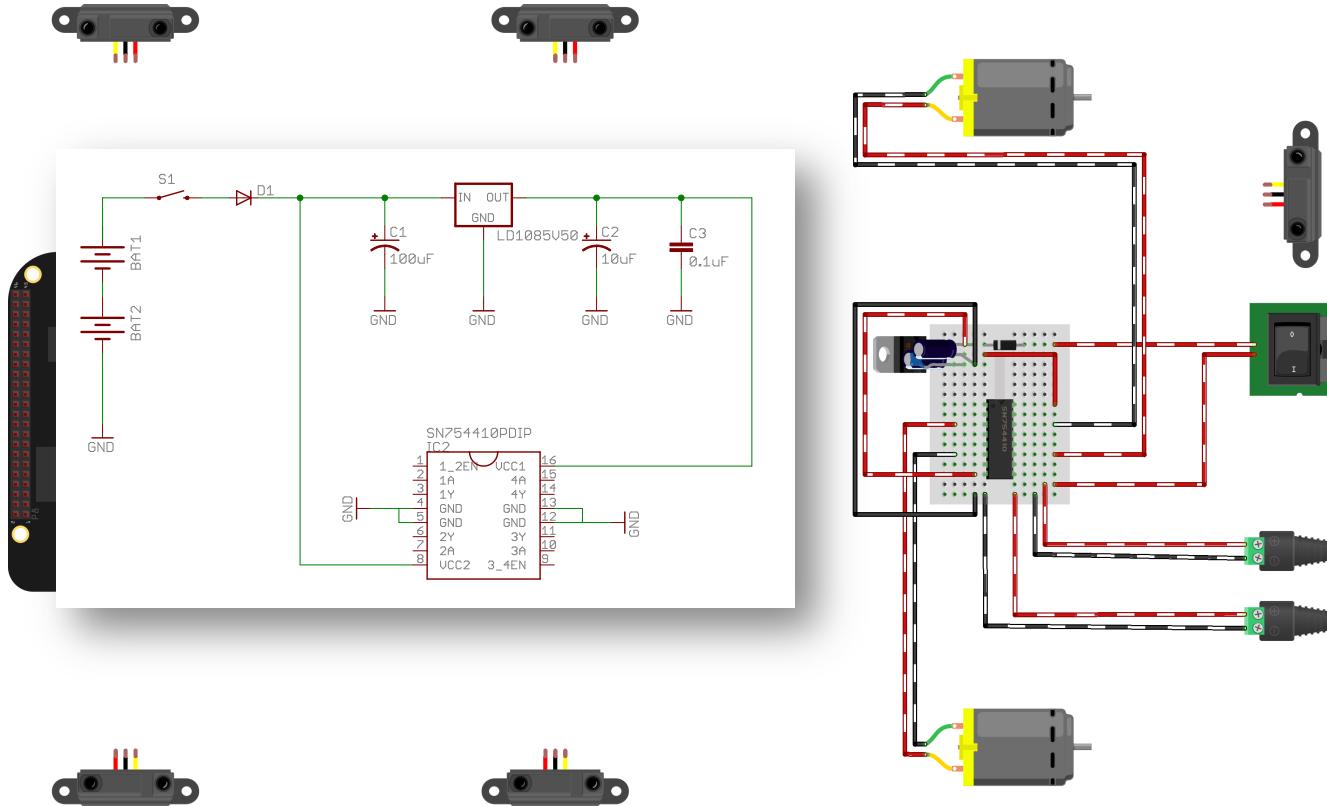
Connect H-Bridge Power – 1st Black Wire



- Two Black M/M Wires
- Two Red M/M Wires

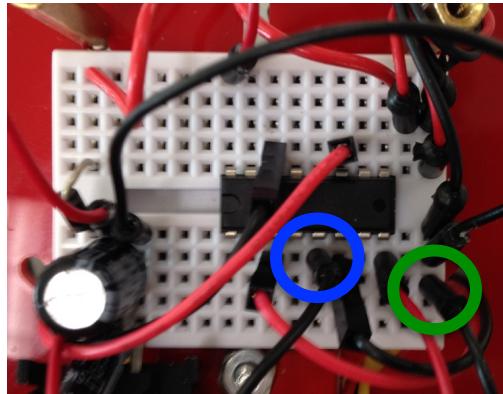
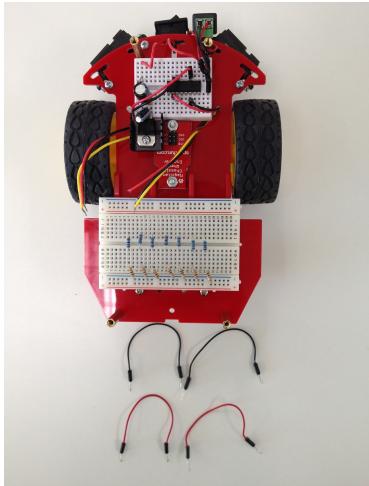
Connect **voltage regulator GND**
to **battery GND**

Connect H-Bridge Power – 1st Black Wire

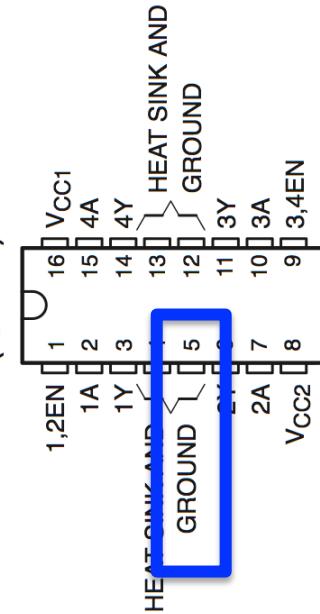


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Connect H-Bridge Power – 2nd Black Wire



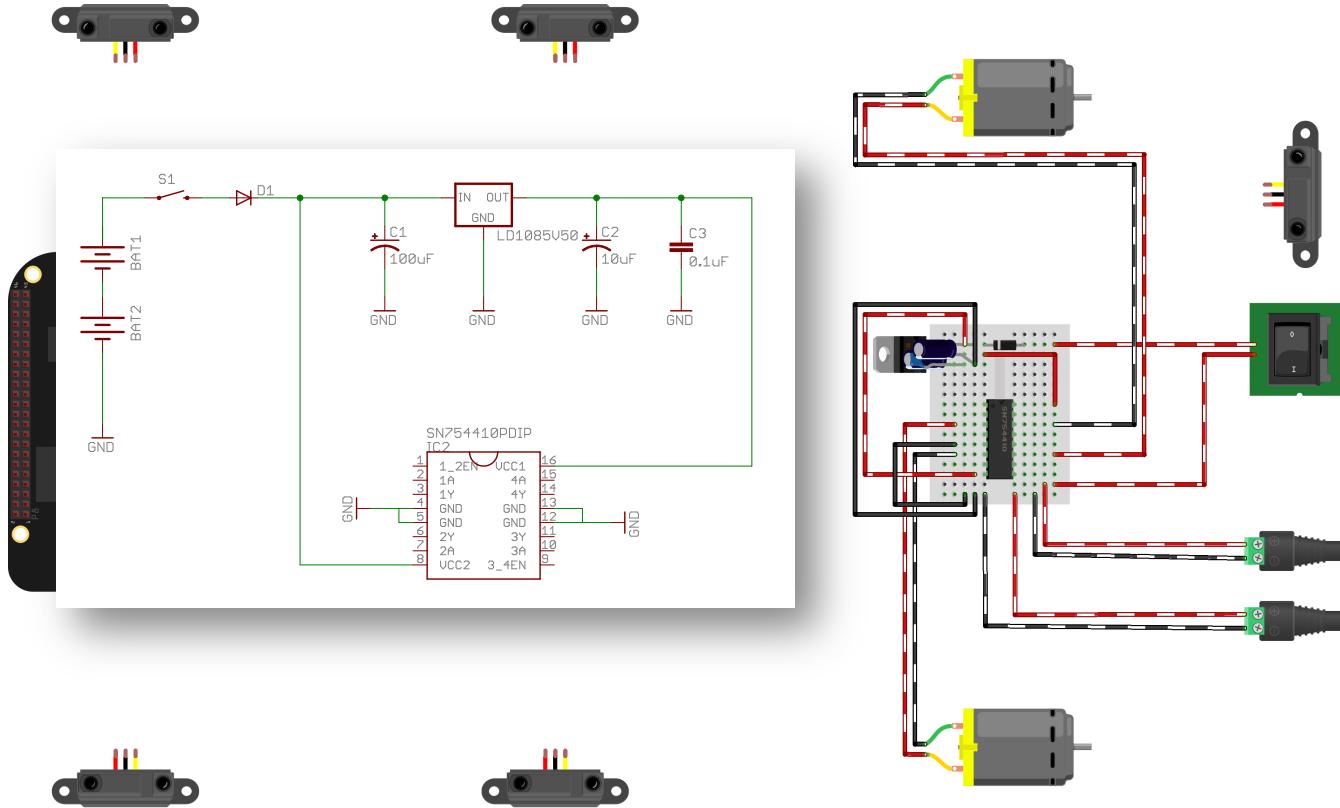
NE PACKAGE
(TOP VIEW)



- Two Black M/M Wires
- Two Red M/M Wires

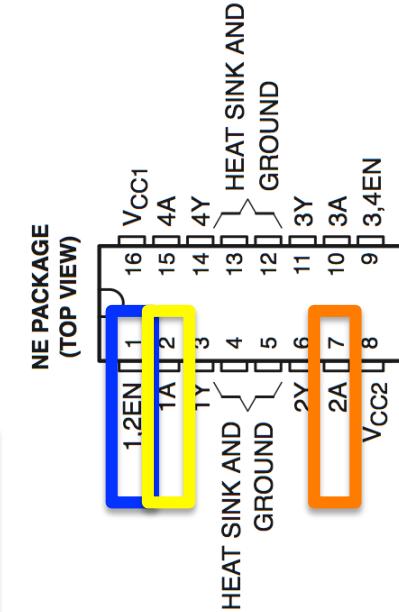
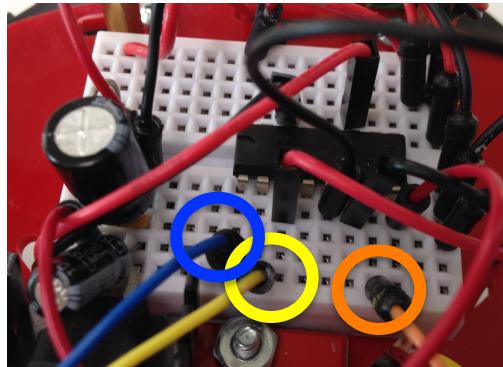
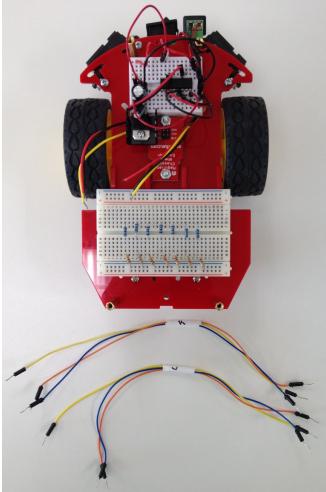
Connect H-Bridge GND (Pin 5) to battery GND

Connect H-Bridge Power – 2nd Black Wire



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Connect Motor Control Wires – Right Motor



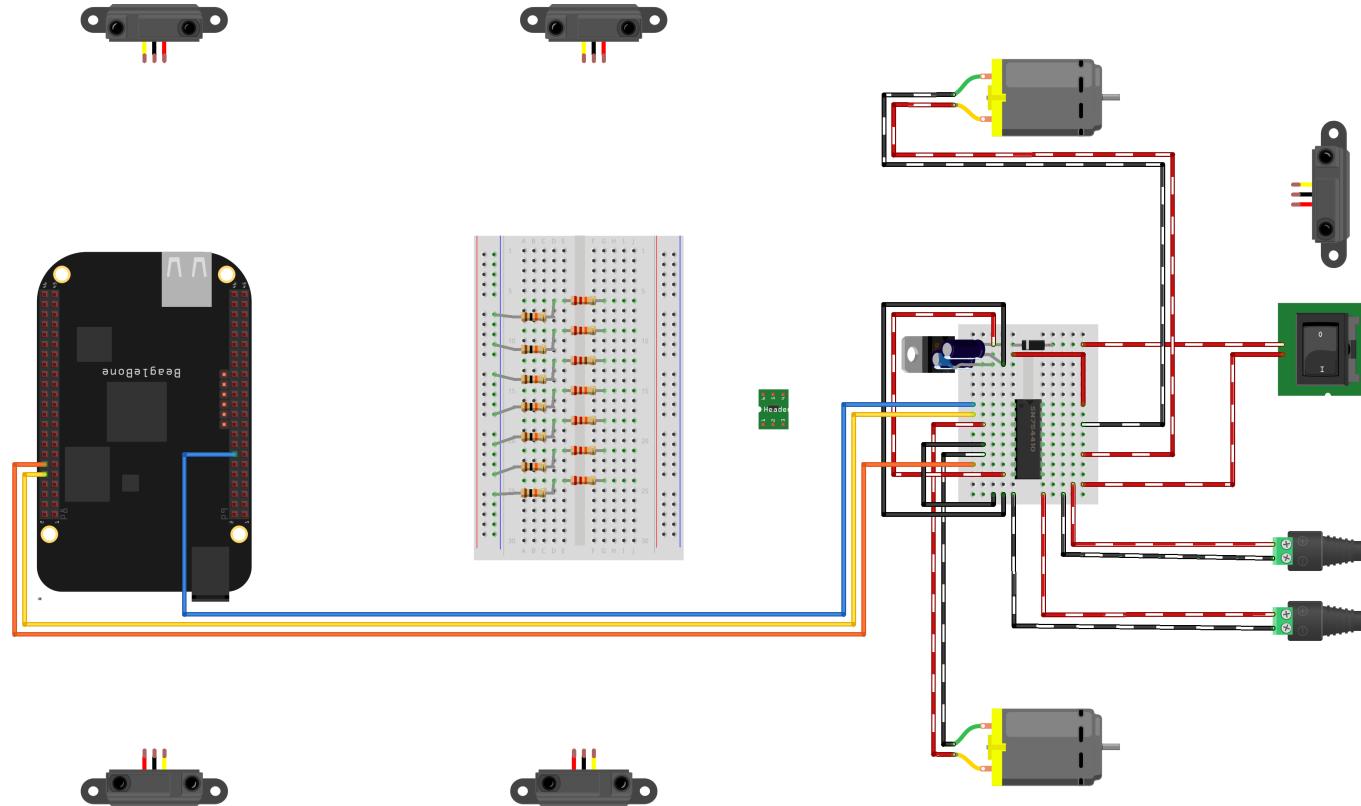
- Connect Blue Wire to H-Bridge 1,2EN (Pin 1)
- Connect Yellow Wire to H-Bridge 1A (Pin 2)
- Connect Orange Wire to H-Bridge 2A (Pin 7)

• Two Groups of Blue, Yellow, & Orange M/M Wires

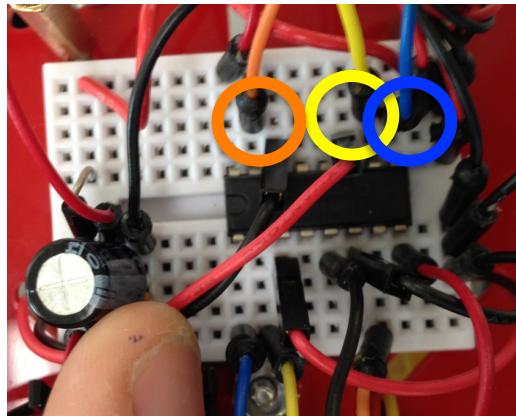
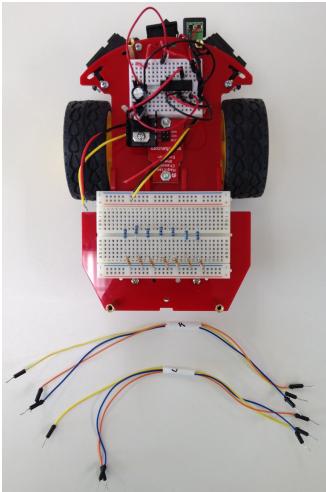
Caution: Triple check that you have wired this connection correctly.

If this is wired incorrectly there is a good chance you will burn out your BeagleBone Black!

Connect Motor Control Wires – Right Motor



Connect Motor Control Wires – Left Motor



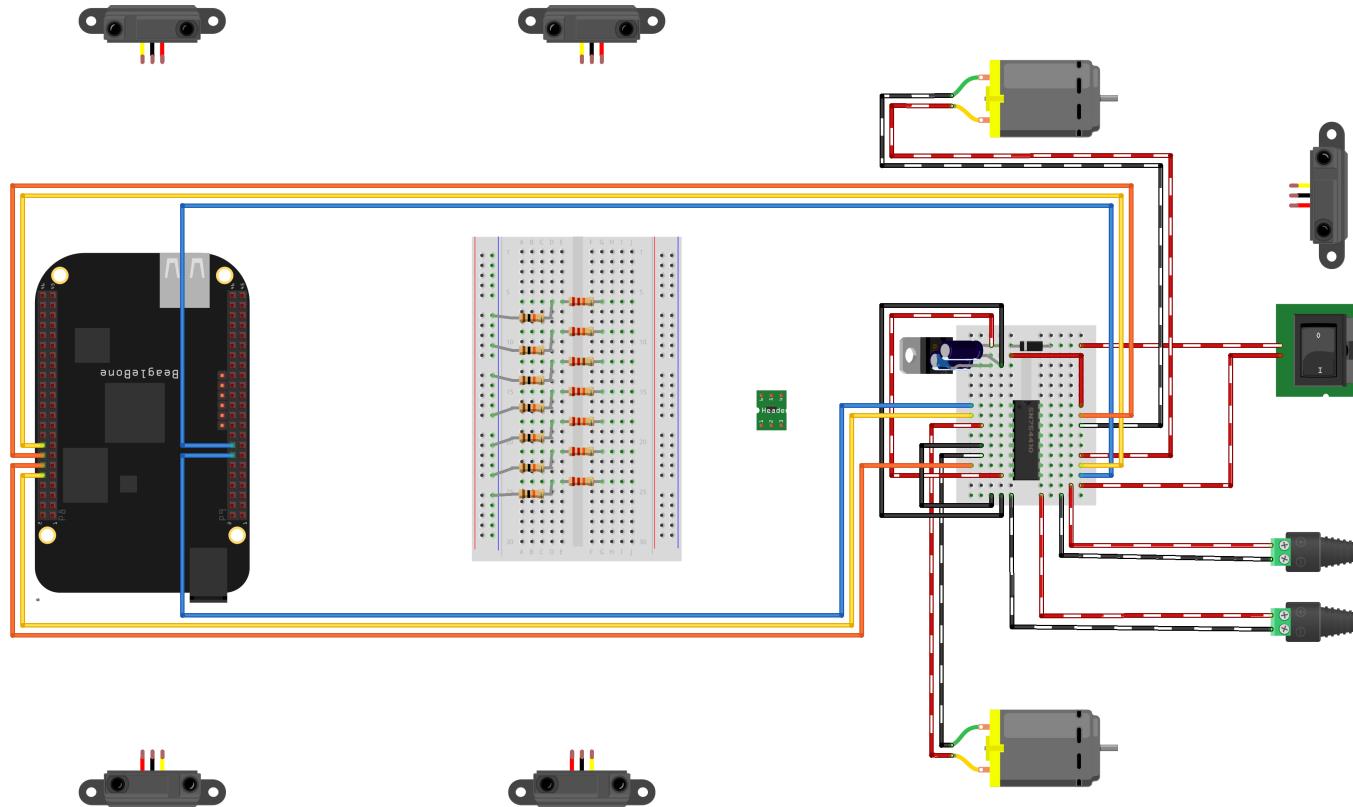
- Connect Blue Wire to H-Bridge 3,4EN (Pin 9)
- Connect Yellow Wire to H-Bridge 3A (Pin 10)
- Connect Orange Wire to H-Bridge 4A (Pin 15)

• Two Groups of Blue, Yellow, & Orange M/M Wires

Caution: Triple check that you have wired this connection correctly.

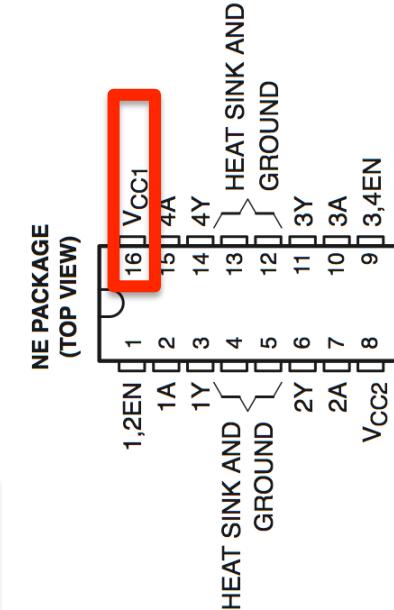
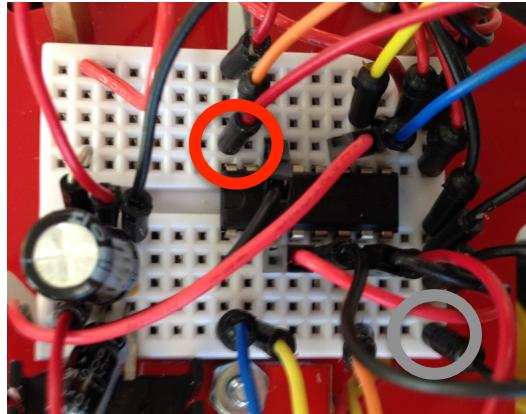
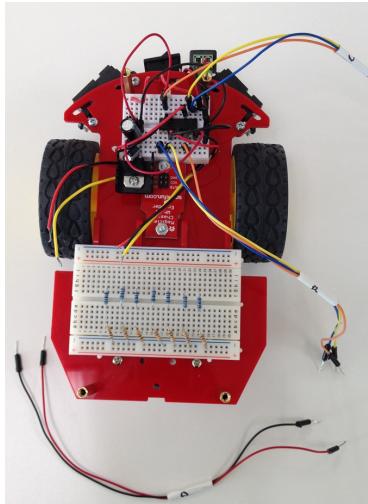
If this is wired incorrectly there is a good chance you will burn out your BeagleBone Black!

Connect Motor Control Wires – Left Motor



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Connect BBB Power

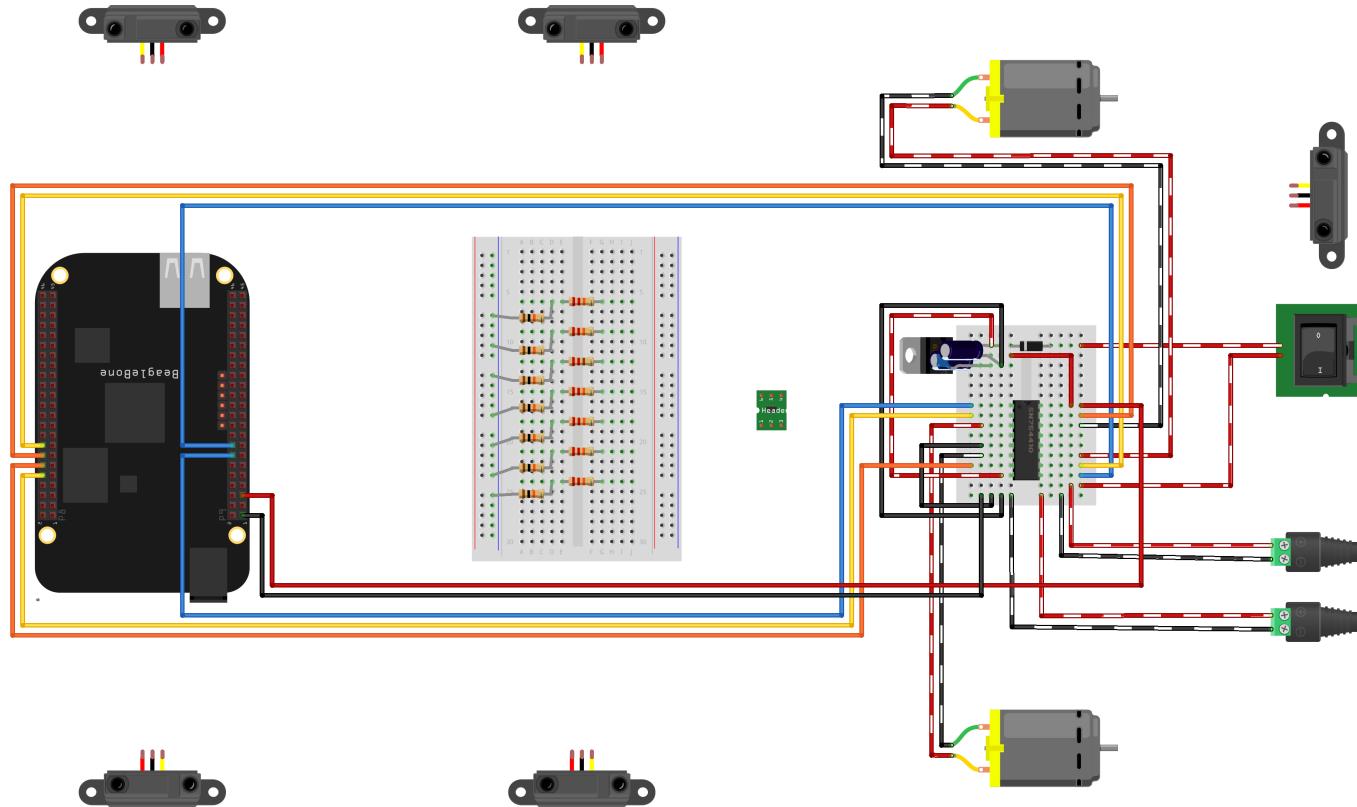


- One Group of Red & Black M/M Wires

- Connect Red Wire to H-Bridge Vcc1 (Pin 16)
- Connect Black Wire to battery GND

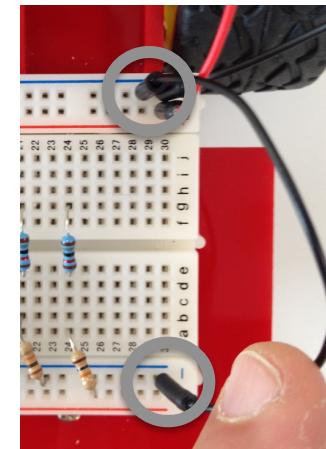
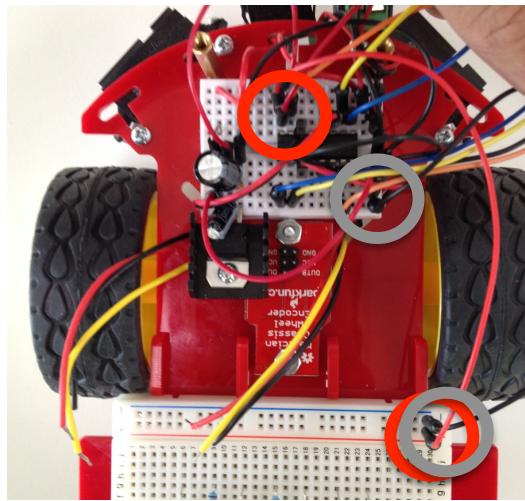
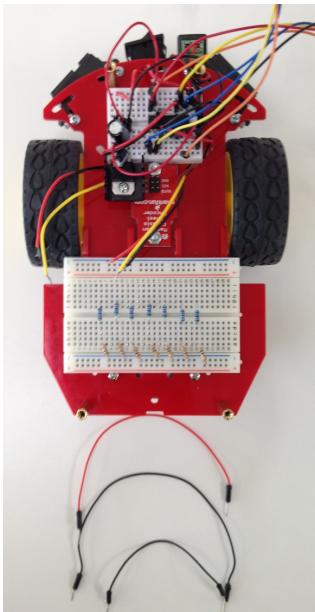
Caution: Triple check that you have wired this connection correctly.
If this is wired incorrectly there is a good chance you will burn out your BeagleBone Black!

Connect BBB Power

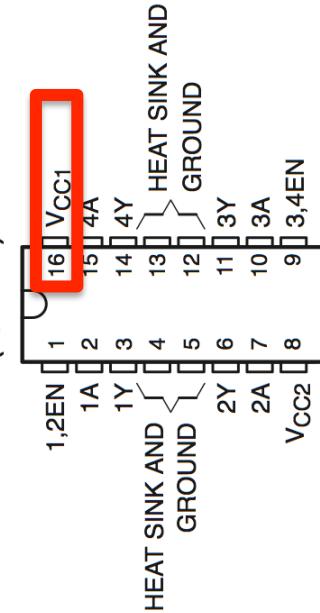


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Connect Big Breadboard Power



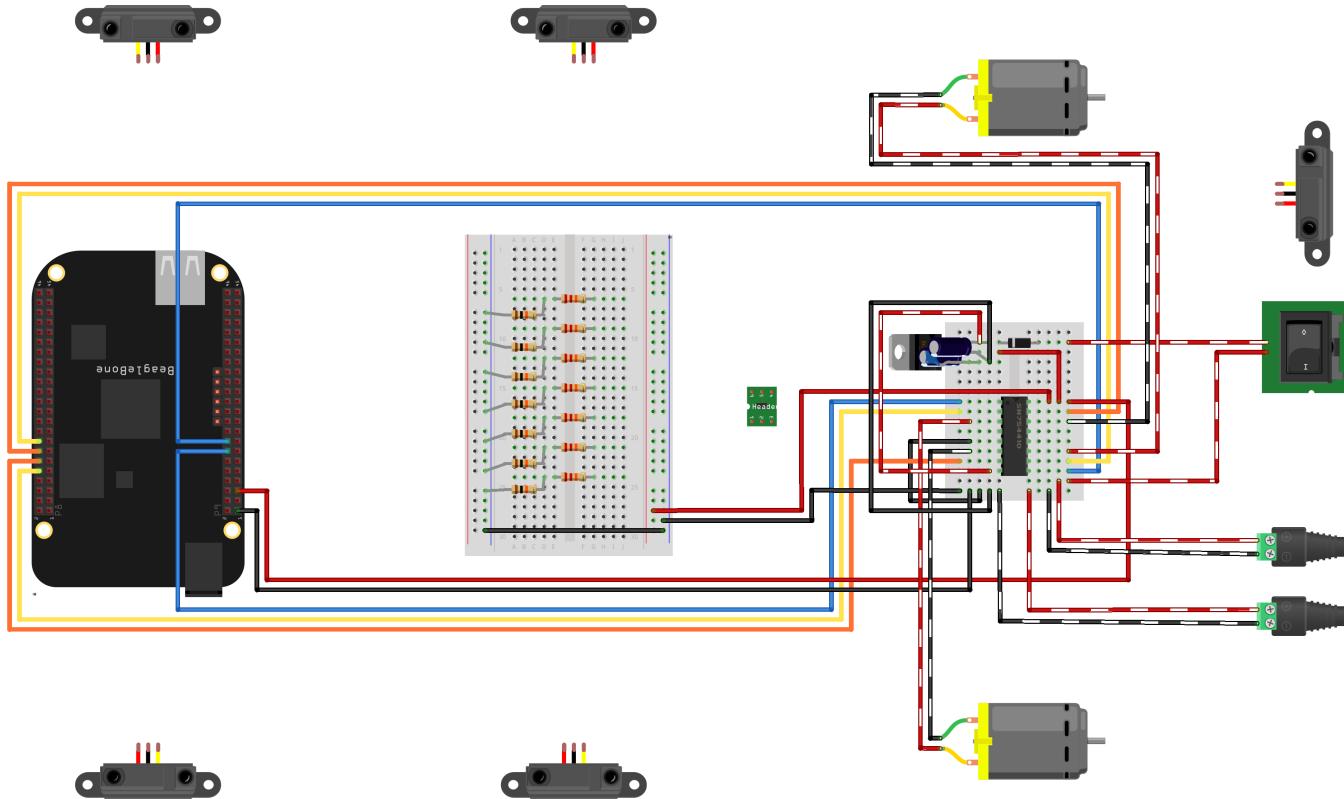
NE PACKAGE
(TOP VIEW)



- One Red M/M Wires
- Two Black M/M Wires

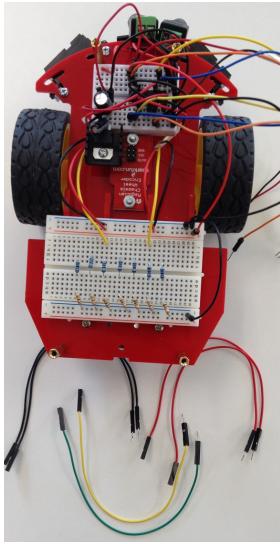
- Connect Red Wire to H-Bridge Vcc1 (Pin 16)
- Connect Black Wire to battery GND
- Connect Black Wire to GND rails on breadboard

Connect Big Breadboard Power



fritzing

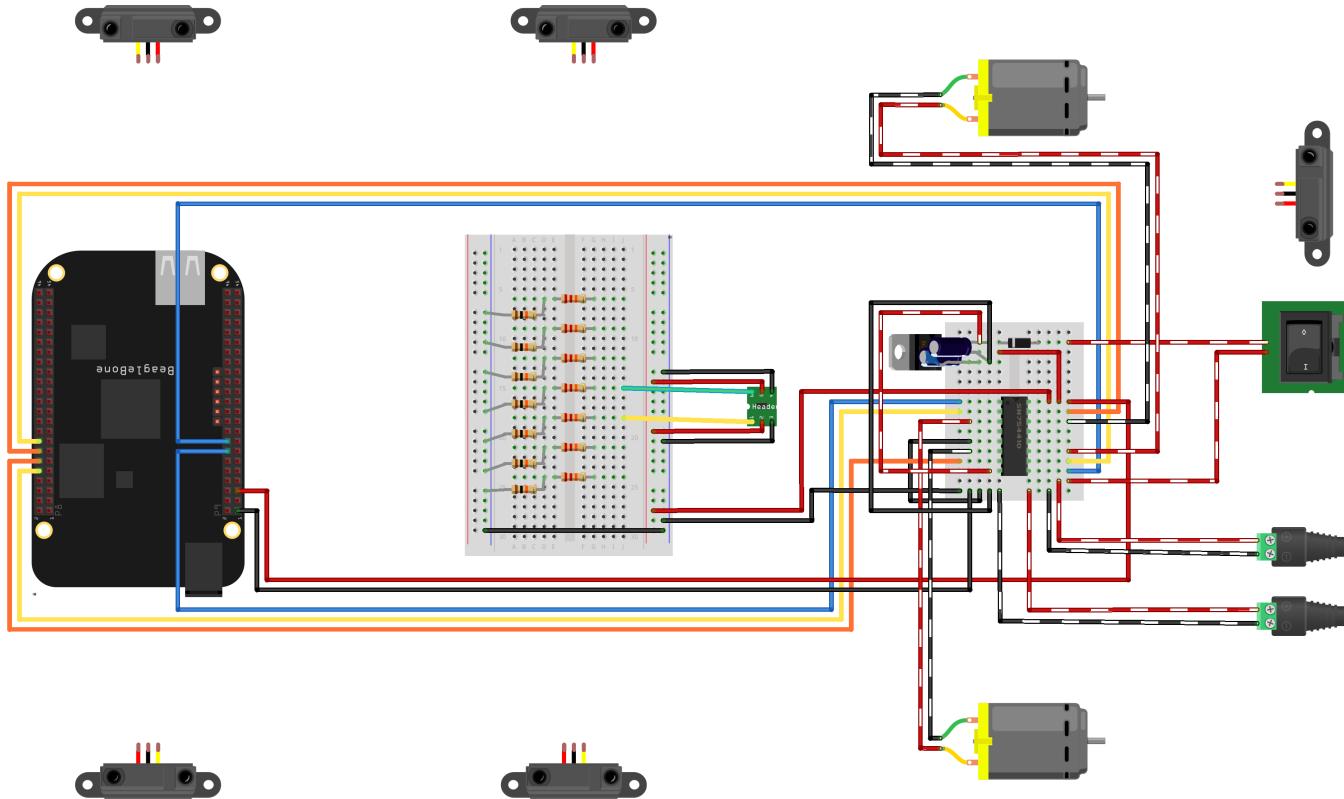
Connect Encoder



- Two Black M/M Wires
- Two Red M/F Wires
- One Green M/F Wire
- One Yellow M/F Wire

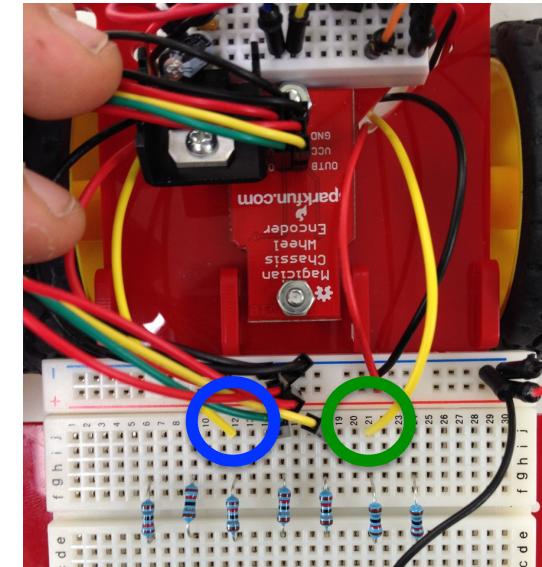
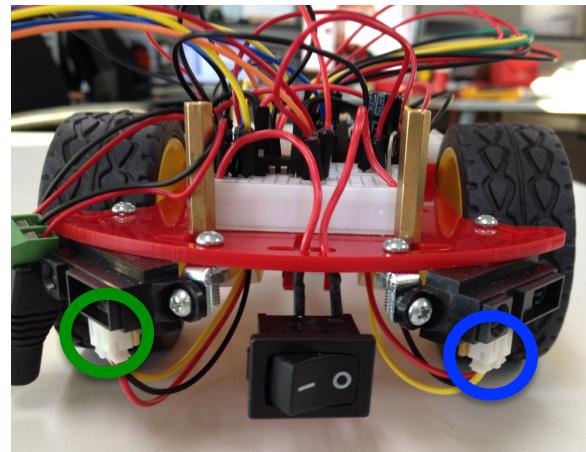
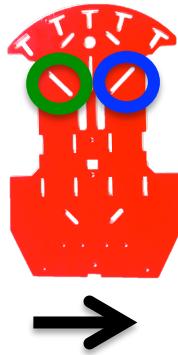
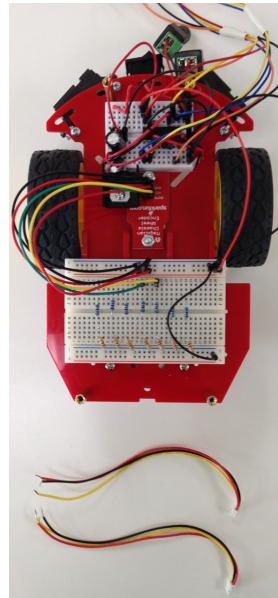
- Connect Black Wires to Encoder GND and GND rail
- Connect Red Wires to EncoderVCC and VCC rail
- Connect Green Wire to Left Encoder OUT and breadboard row 15
- Connect Yellow Wire to Right Encoder OUT and breadboard row 18

Connect Encoder



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Connect Front Lower IR Sensors

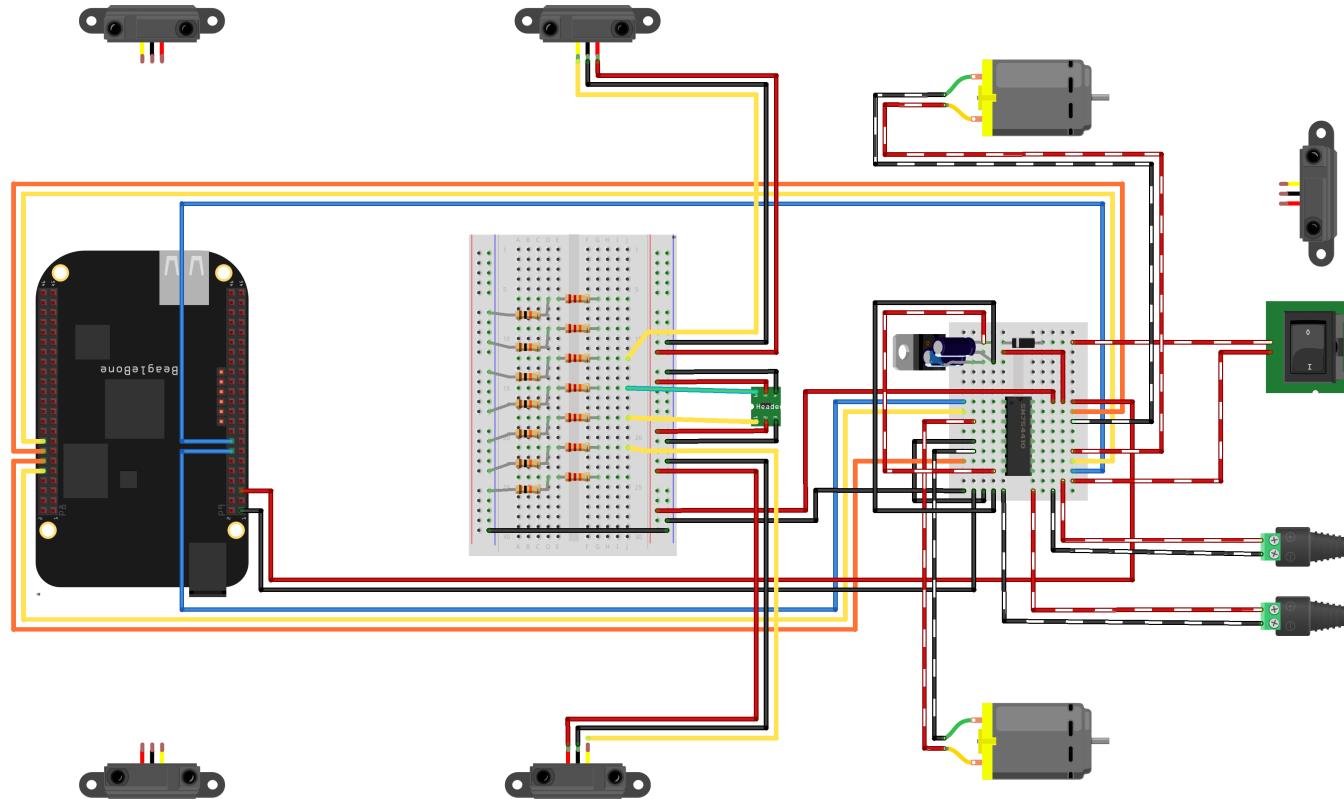


Route wires up through chassis

- Two JST 3-Wire Jumper

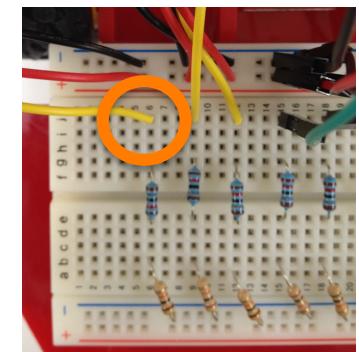
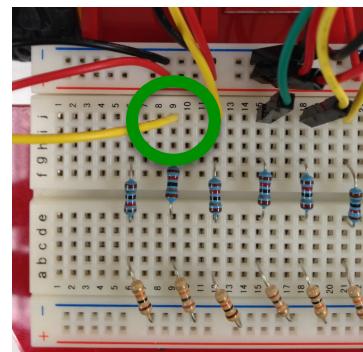
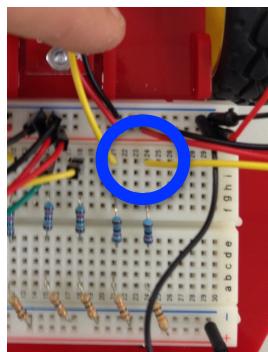
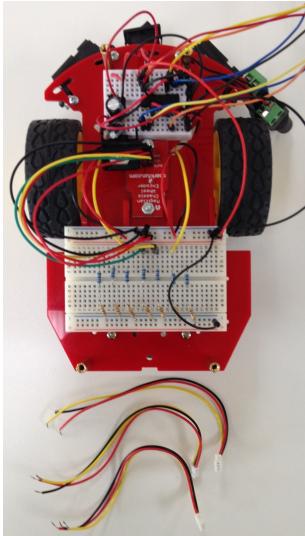
- Connect Black Wires to GND rail
- Connect Red Wires to VCC rail
- Connect Left IR Signal Wire to breadboard row 12
- Connect Right IR Signal Wire and breadboard row 21

Connect Front Lower IR Sensors



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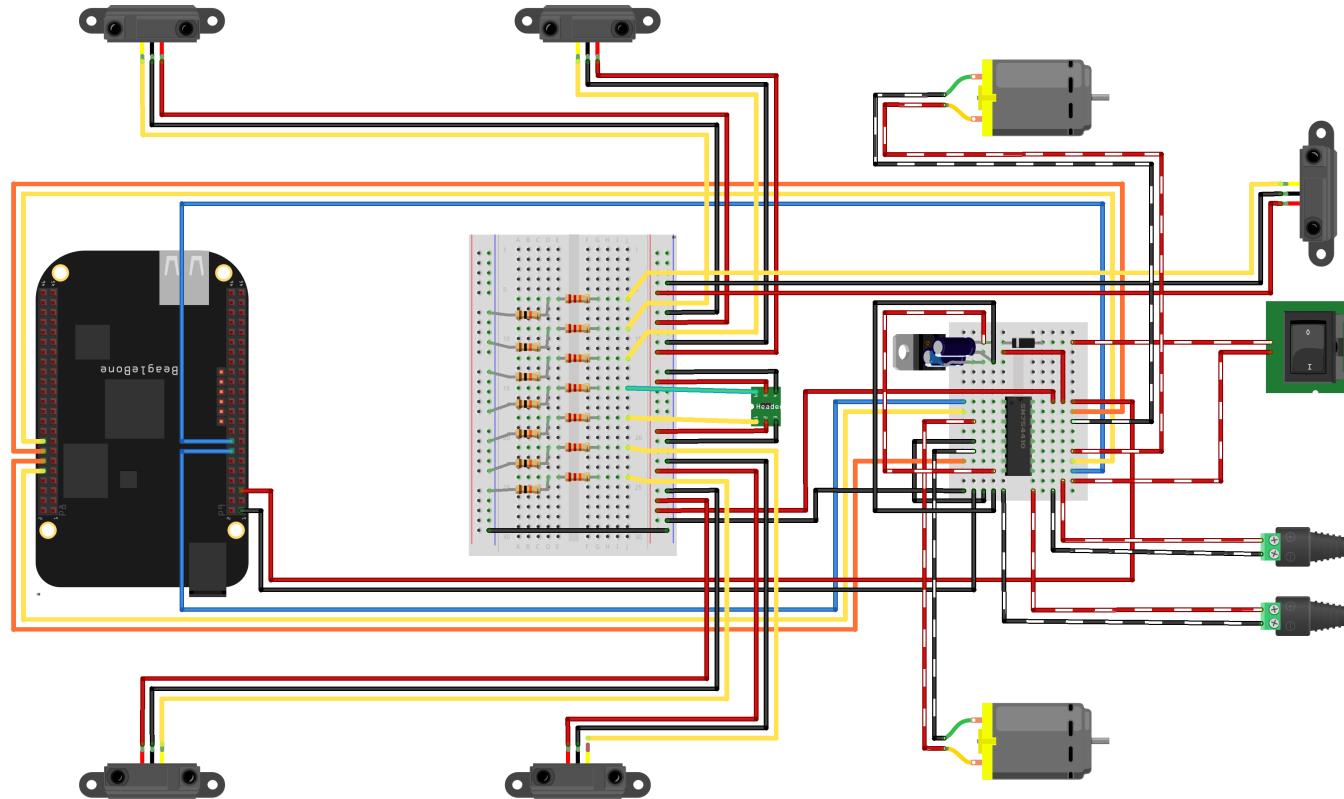
Connect Upper IR Sensors



- Three JST 3-Wire Jumper

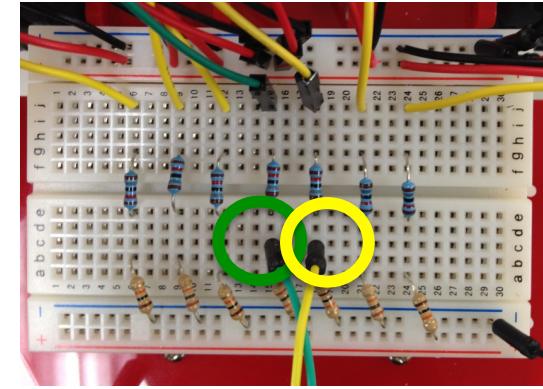
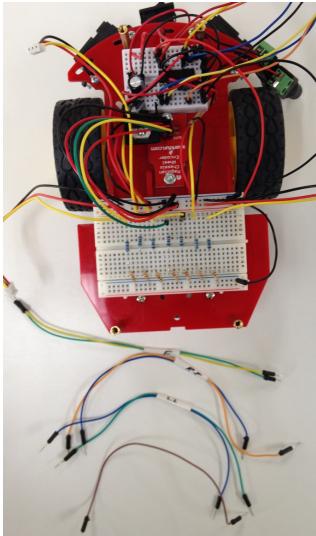
- Connect Black & Red Wires to rails
- Connect Signal Wire to breadboard row 24
- Connect Signal Wire to breadboard row 9
- Connect Signal Wire to breadboard row 6

Connect Upper IR Sensors



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Connect ADC to BBB - Encoders

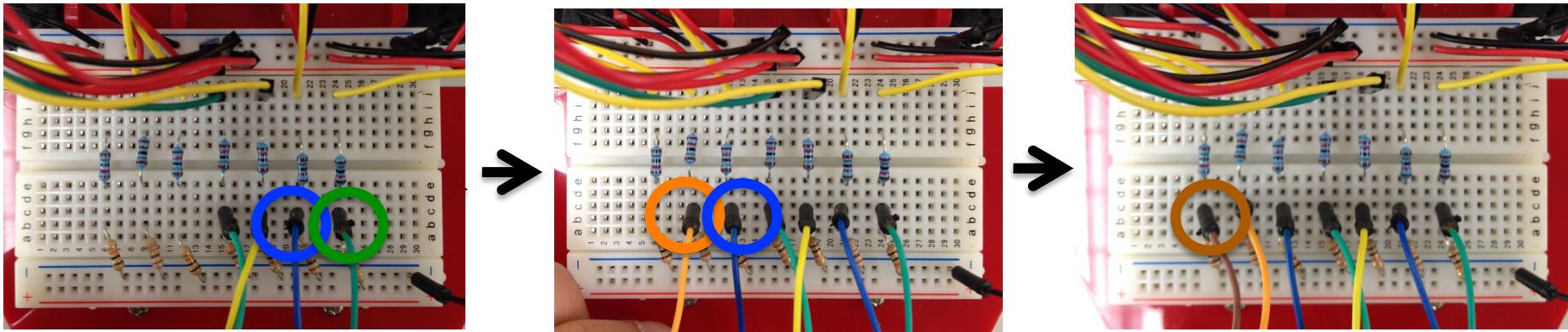


- One Group of Green & Yellow M/M Wires
- One Group of Blue & Green M/M Wires
- One Group of Orange & Blue M/M Wires
- One Brown M/M Wire

From Green & Yellow Group:

- Connect Green Wire to breadboard row 15
- Connect Yellow Wire to breadboard row 18

Connect ADC to BBB – Infrared Sensors



From Blue & Green Group:

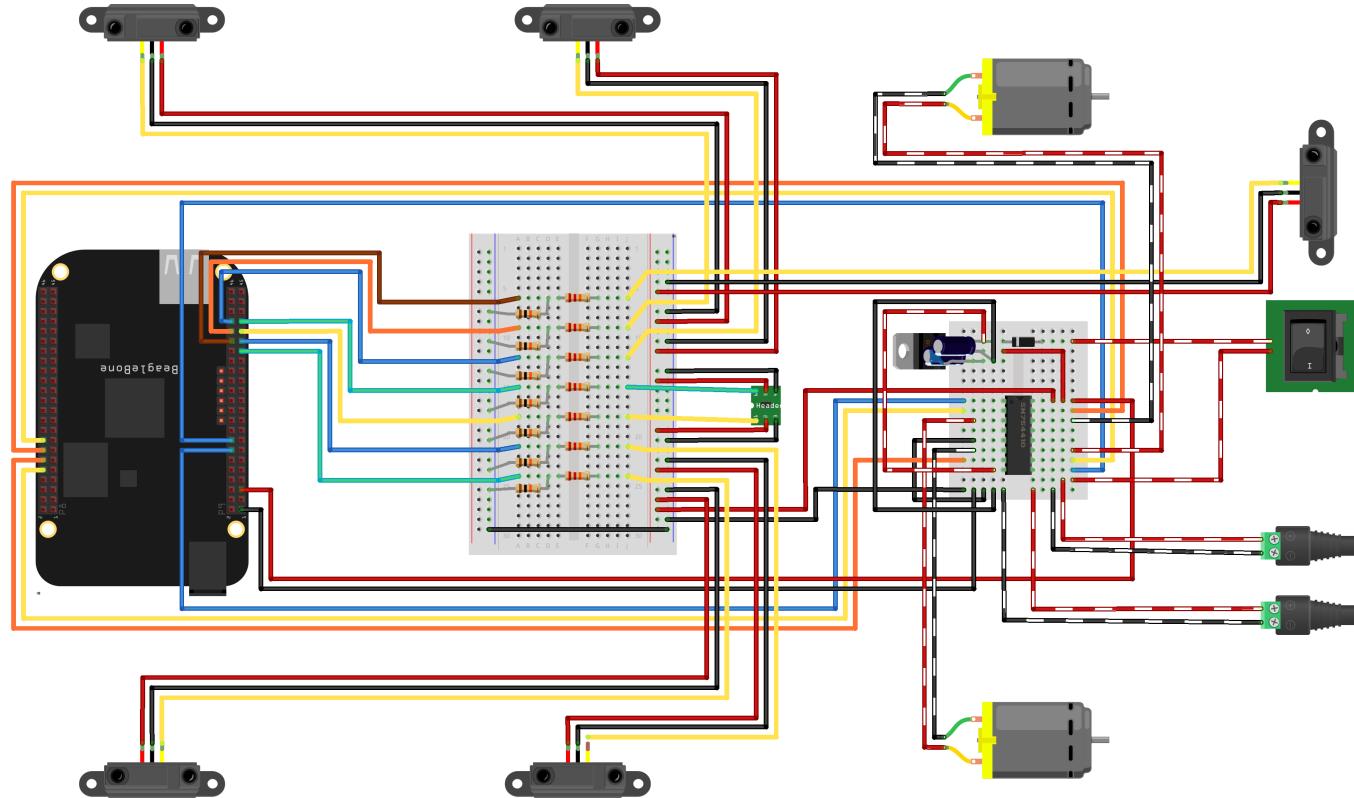
- Connect **Blue** Wire to **breadboard row 21**
- Connect **Green** Wire to **breadboard row 24**

- Connect **Brown** Wire to **breadboard row 6**

From Orange & Blue Group:

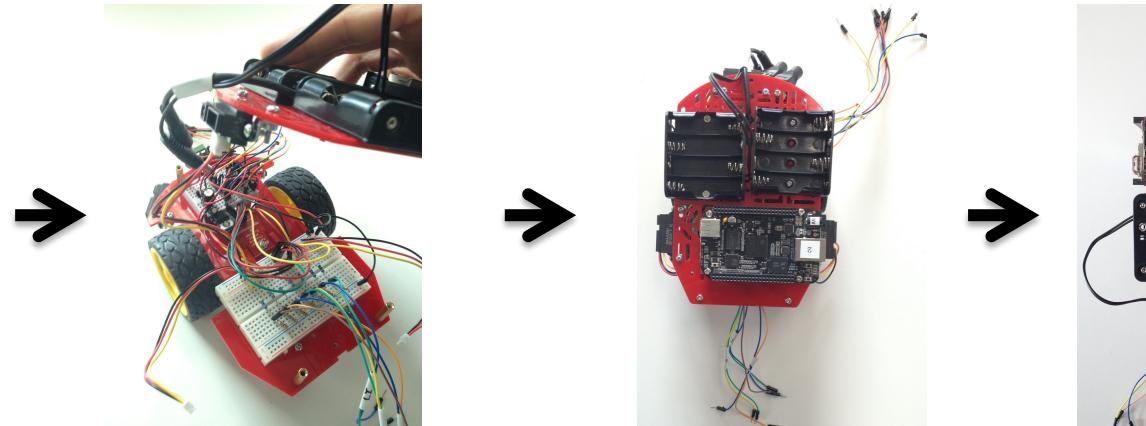
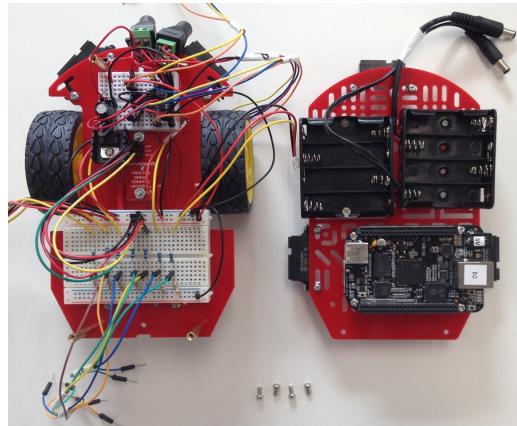
- Connect **Orange** Wire to **breadboard row 9**
- Connect **Blue** Wire to **breadboard row 12**

QuickBot Wiring



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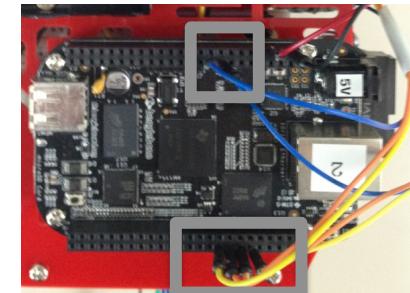
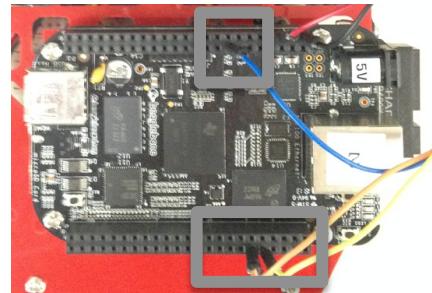
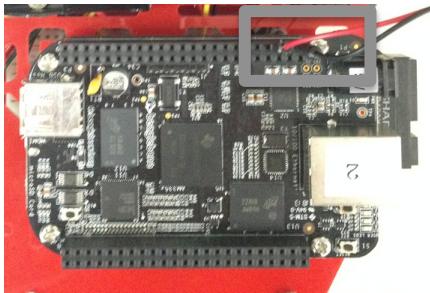
Add Top Plate



- Four M3*6 Screws

1. Attach JST wire to front IR sensor
2. Attach top plate
3. Attach JST wires to side IR sensors

Wire BBB

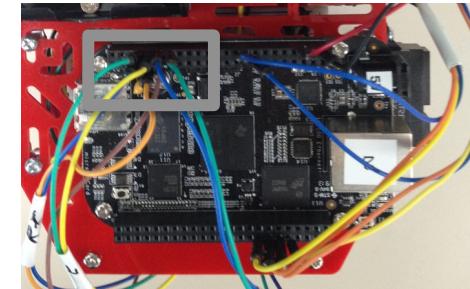
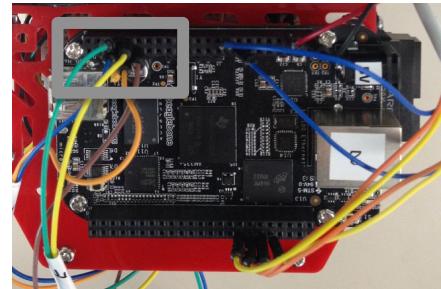
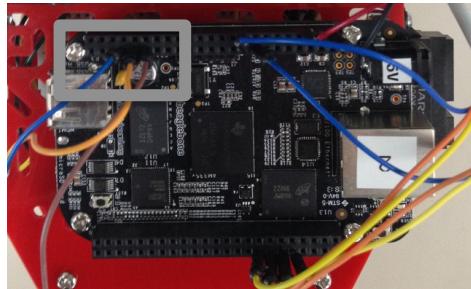
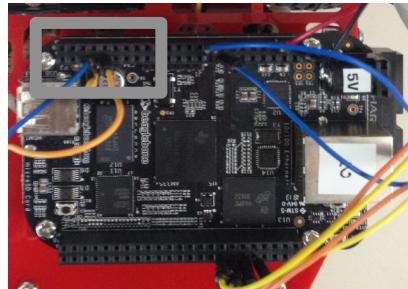


- Connect 5V to BBB 5V_Raw (Pin P9_05)
- Connect GND to BBB GND (Pin P9_01)

- Connect Right Motor Blue to BBB GPIO_51(Pin P9_14)
- Connect Right Motor Yellow to BBB GPIO_68 (Pin P8_10)
- Connect Right Motor Orange to BBB GPIO_44 (Pin P8_12)

- Connect Left Motor Blue to BBB GPIO_05(Pin P9_16)
- Connect Left Motor Yellow to BBB GPIO_46 (Pin P8_16)
- Connect Left Motor Orange to BBB GPIO_26 (Pin P8_14)

Wire BBB



- Connect Left IR Blue to BBB Ain_1 (Pin P9_40)
- Connect Left IR Orange to BBB Ain_3 (Pin P9_38)



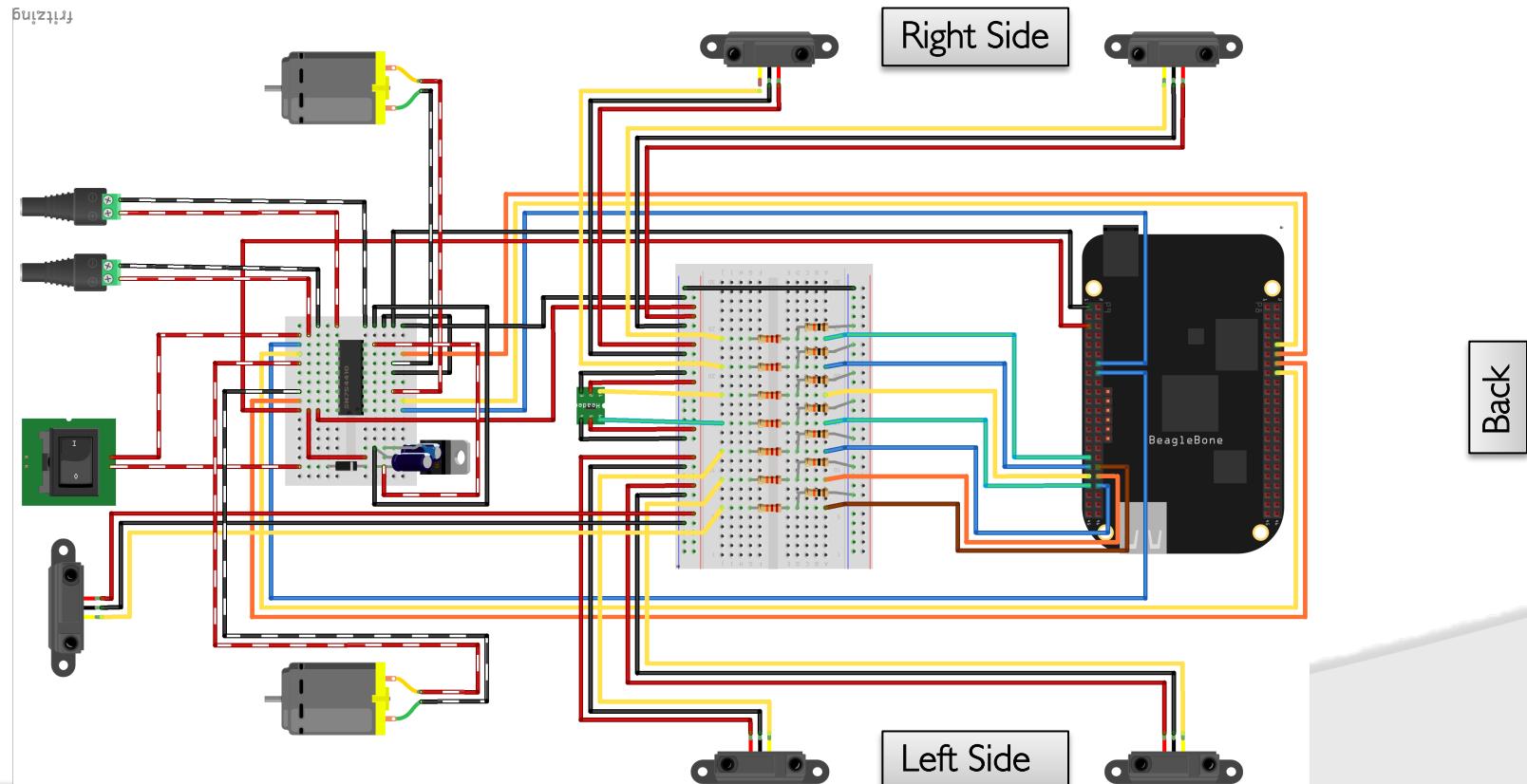
- Connect Encoder Green to BBB Ain_0 (Pin P9_39)
- Connect Encoder Yellow to BBB Ain_2 (Pin P9_37)

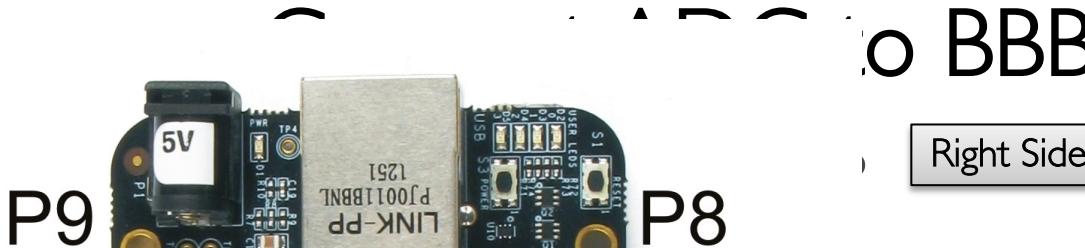
- Connect Front IR Brown to BBB Ain_5 (Pin P9_36)



- Connect Right IR Blue to BBB Ain_6 (Pin P9_35)
- Connect Right IR Green to BBB Ain_4 (Pin P9_33)

Connect ADC to BBB

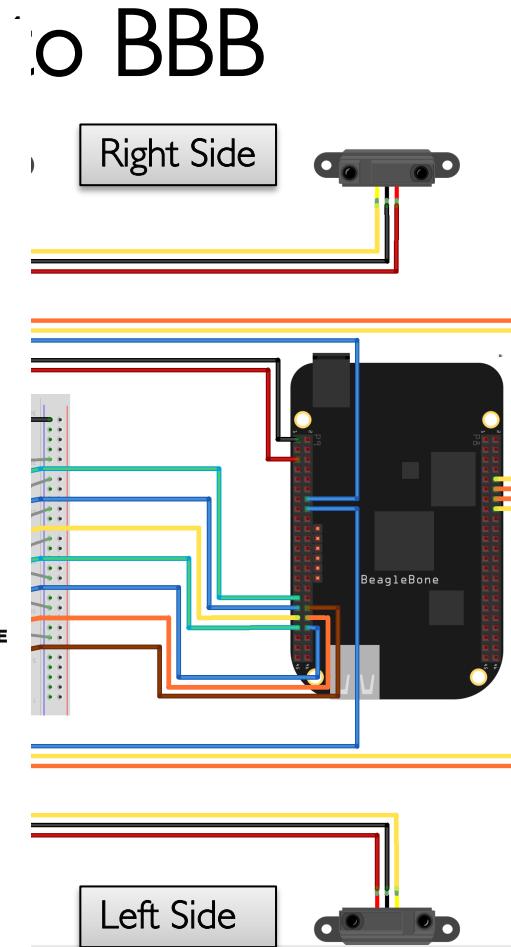




Front

DGND	01	DGND	02	DGND	01
VDD_3V3	03	VDD_3V3	04	VDD_3V3	03
VDD_5V	05	VDD_5V	06	VDD_5V	05
SYS_5	07	SYS_5V	08	SYS_5V	07
PWR_BUT	09	SYS_RESET_N	10	SYS_RESET_N	09
GPIO_30	11	GPIO_60	12	GPIO_60	11
GPIO_31	13	GPIO_40	14	GPIO_40	13
GPIO_48	15	GPIO_51	16	GPIO_51	15
GPIO_04	17	GPIO_05	18	GPIO_05	17
I2C_2_SCL	19	I2C_2_SDA	20	I2C_2_SDA	19
GPIO_03	21	GPIO_02	22	GPIO_02	21
GPIO_49	23	GPIO_15	24	GPIO_15	23
GPIO_117	25	GPIO_14	26	GPIO_14	25
GPIO_125	27	SPI_1_CS0	28	SPI_1_CS0	27
SPI_1_DO	29	GPIO_122	30	GPIO_122	29
SPI_1_SCLK	31	VDD_ADC	32	VDD_ADC	31
AIN_4	33	GND_ADC	34	GND_ADC	33
AIN_6	35	Aln_5	36	Aln_5	35
AIN_2	37	Aln_3	38	Aln_3	37
AIN_0	39	Aln_1	40	Aln_1	39
GPIO_20	41	GPIO_07	42	GPIO_07	41
DGND	43	DGND	44	DGND	43
DGND	45	DGND	46	DGND	45

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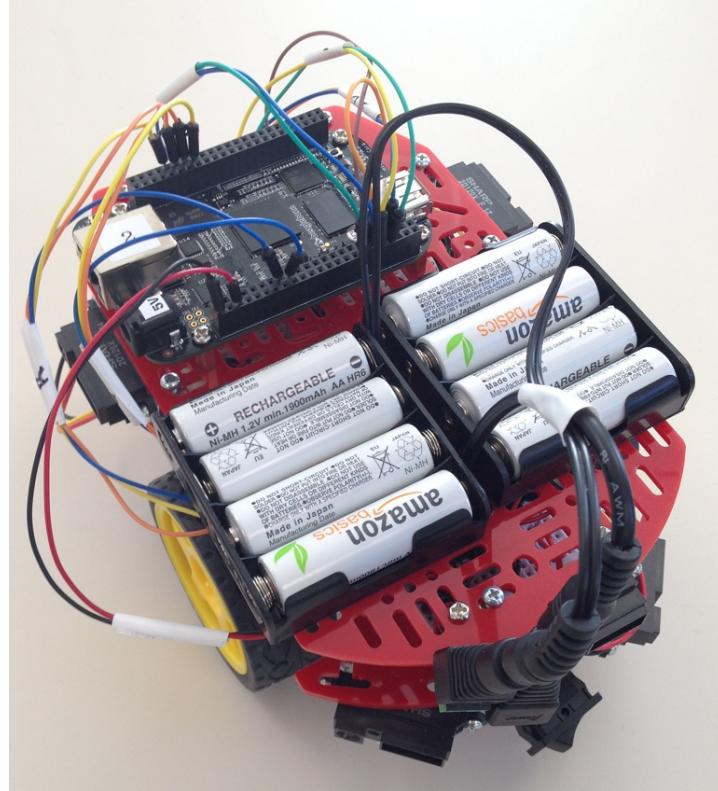


Left Side

Back

Right Side

Install Batteries & Connect DC Plugs



Optionally: Power QuickBot From Wall

- 1st DC Barrel Plug Connector: Cut barrel plug and connect ends
- 2nd DC Barrel Plug Connector: Use DC Power Supply with output 9-12V, \geq 1Amp



CAUTION: DON'T USE WITH BATTERIES INSTALLED!!!

Learn From My Mistakes

Ways I killed some BeagleBone Blacks:

1. Mixed up 5V and battery voltage wiring
2. Plugged BBB GPIO wire into motor breadboard hole
3. Set BBB down on a screw while it was powered on
4. Loosened brass standoff and the BBB touched it while it was powered on

