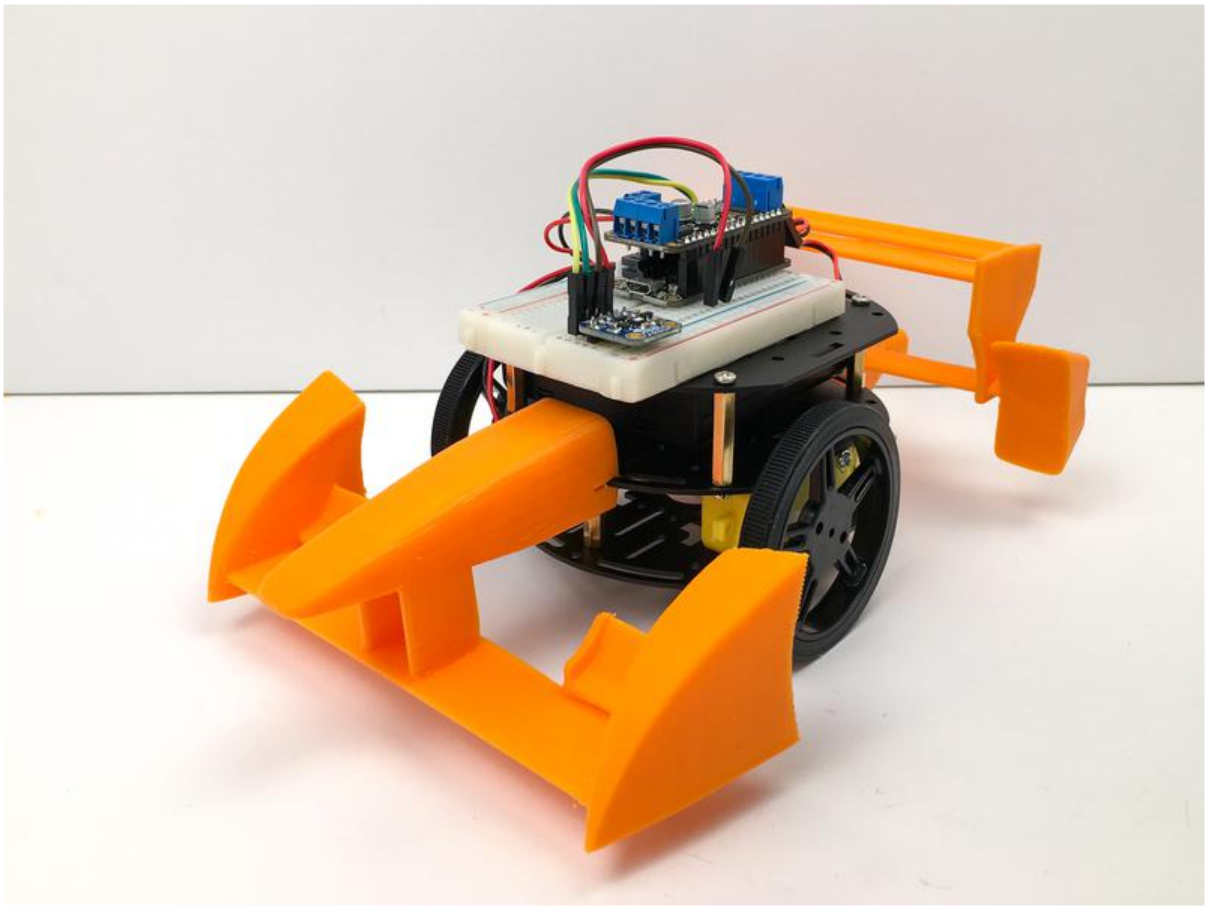
My Mini Race Car

Created by John Park



https://learn.adafruit.com/my-mini-race-car

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Table of Contents

Introduction 5

Unboxing Your Mini Race Car Kit 7

• Kit Contents
• Feather, USB Cable, & Batteries
• Car Chassis & Assembly Tools
• Prototyping Parts and Components

Assembling and Wiring Your Mini Race Car 9

• Motors and Wheels and Tires
• Lower Chassis
• Turn over the plate
• Turn over the plate again
• Prepare the Battery Box
• Middle Chassis Layer
• Prepare the Electronics
• LiPoly Battery

3D Printed Car Parts 24

• Bonus Body Parts

How Your Race Car Works: The Basics 31

• Board Support Package and Drivers
• Libraries
• DC Motor Test
• Let's Get Moving

Code for Your Race Car 37

• Libraries
• The Code

Driving Your Race Car 38

Temperature and Humidity Data 41

• Power Pins:
• I2C Logic pins:
• Download Adafruit_HTU21DF
• Load Demo
• Bluetooth Data Streaming
• Plotting
• Sensor Placement

Make Your Race Car Autonomous 48

• Mounting the Sensors
• The Code

Control Your Race Car's Speed 52

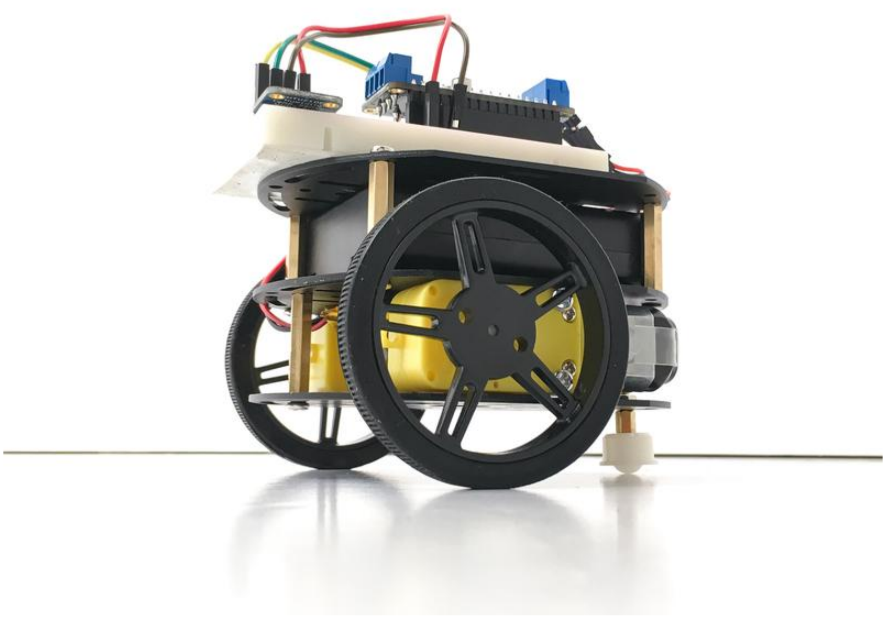
• Using the Controller to Control Speed

Connecting Your Race Car to Adafruit IO 57

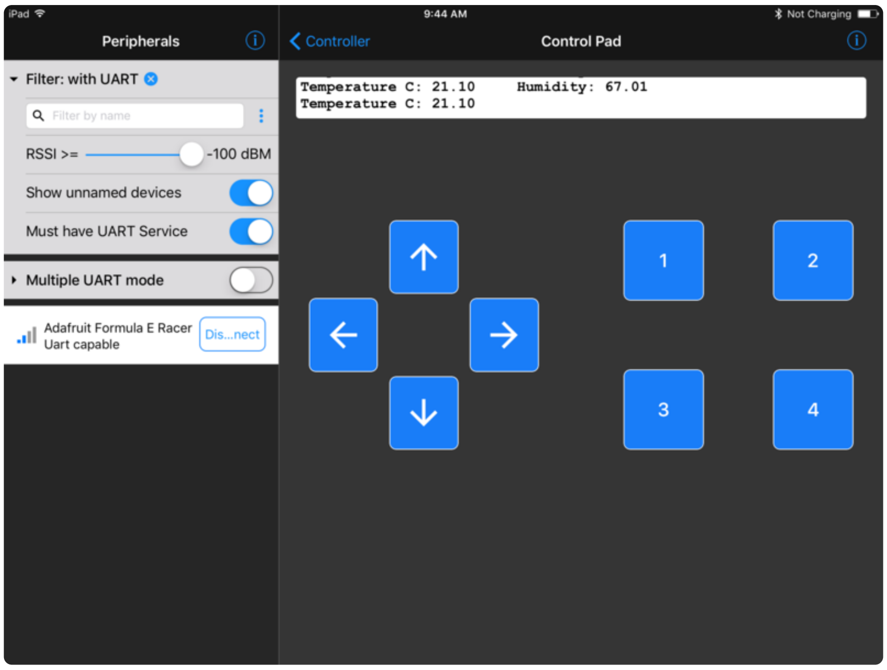
• Sign up for Adafruit IO and create your first dashboard.

- Send data to Adafruit IO

Introduction



Get ready to race down the track with your Feather microcontroller-based Mini Race Car! You'll build this high performance racer, using the Bluetooth LE capable Feather 32u4 Bluefruit LE board, Motor Driver FeatherWing, and TE HTU21D-F temperature & humidity sensor to give you racetrack telemetry data.



Filter: with UART

RSSI >= -100 dBM

Show unnamed devices

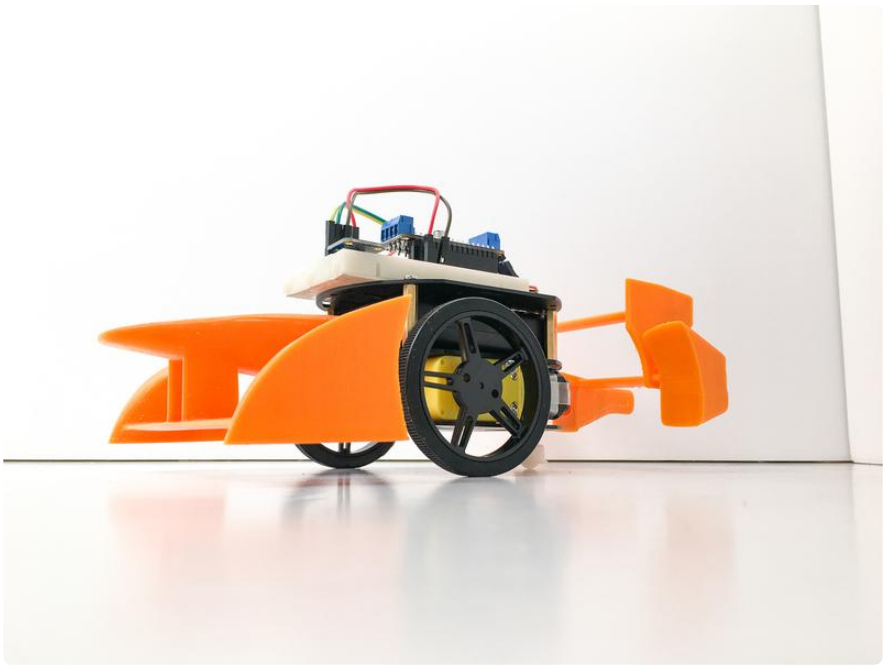
Must have UART Service

Multiple UART mode

```
Temperature C: 21.10     Humidity: 67.01
Temperature C: 21.10
```

All of this is controlled from your mobile device using the free Bluefruit Connect app for iOS and Android.

Let's get started!!



Unboxing Your Mini Race Car Kit

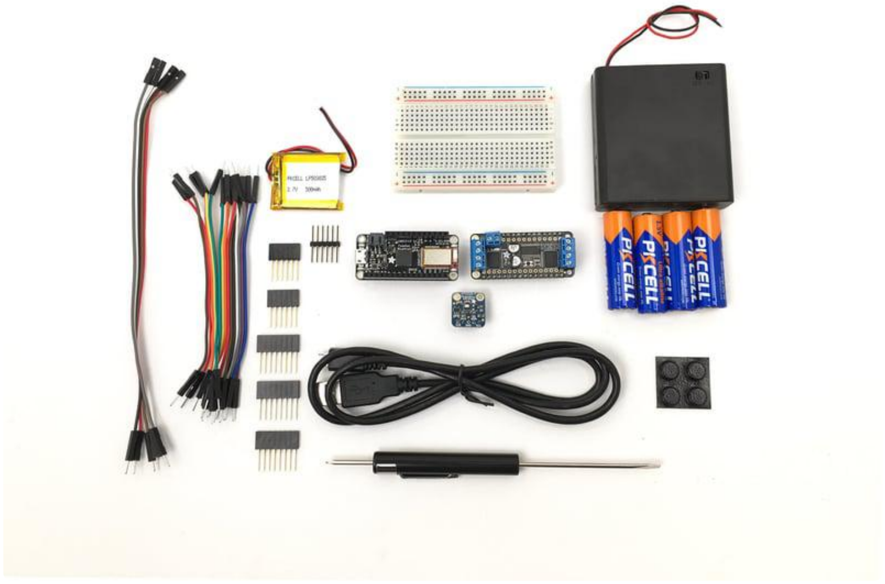
SHARE YOUR CUSTOMIZED CAR DESIGN USING #MYMINIRACECAR
adafruit
Visit digikey.com/racing to learn more!

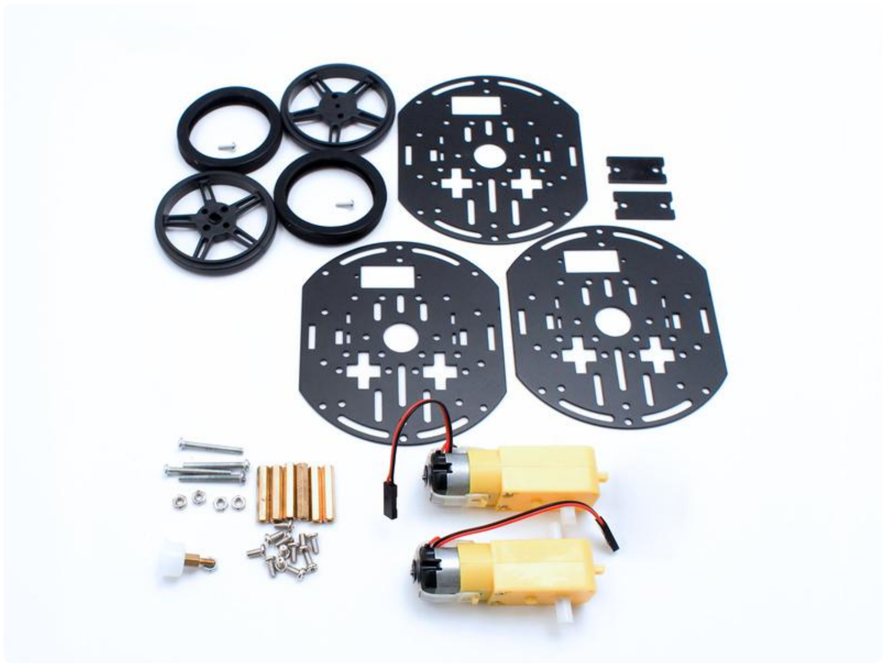
My Mini Race Car is designed to introduce you to the joys of making with electronics. We decided to come up with a fun pack of parts that:

- Could introduce a beginner to making
- Teach electronics and programming skills
- Does not assume any prior experience
- Does not require any soldering or special tools

Kit Contents

After a lot of thinking, here's what we came up with:





Feather, USB Cable, & Batteries

- Feather 32u4 Bluefruit LE is the brains of your race car! It is Arduino-compatible and has Bluetooth wireless control
- Motor FeatherWing is the muscle of this car, providing power to the motors -- Lets you drive up to 4 DC or 2 stepper motors- certainly enough motors to power the car kit!
- TE HTU21D-F is the heart of your race car. Temperature & Humidity sensor breakout board for realtime car/track sensing!

- 1x USB Cable - Standard A-B - 3 ft/1m (http://adafru.it/62) - use this to install new code onto your Feather (from any computer)
- 3.7V LiPoly battery - this battery will power your Feather (but not the motors)
- 4x AA Batteries (http://adafru.it/3349) - Use these to power your the motors of your super awesome little race car

Car Chassis & Assembly Tools

- Three layer Robot Chassis Kit in Black (http://adafru.it/3244) - This kit gives you everything you need to build the shell of a 2-wheel-drive Mobile Platform Robot to help you channel your inner Mario Andretti
- Pocket Screwdriver with Philips and slotted ends

Prototyping Parts and Components

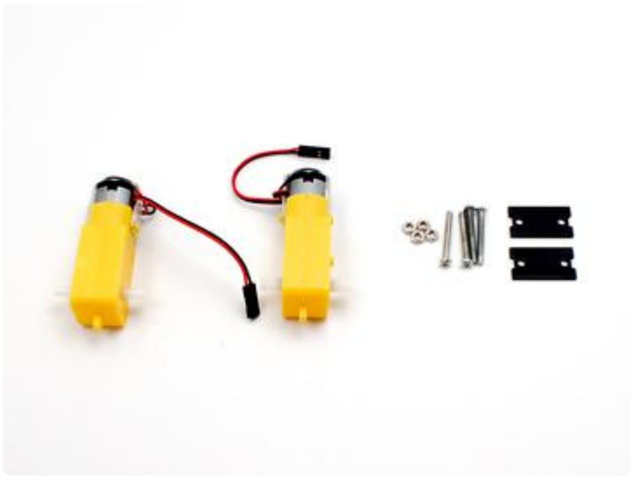
- Half Size Breadboard Perfect fit for your car kit. Your Feather will connect to the breadboard, allowing you to easily plug in other sensor, LEDs, buzzers, potentiometers, switches, and more
- 1x 4xAA Battery Holder w/ On/Off Switch () - A nice portable battery holder for your car's motor batteries.
- 1x Shield stacking headers for Arduino (http://adafru.it/85) - Allow optional plugging in of many different boards, sensors, and wiring
- 1x Rubber Bumper Feet () - Helps keep the battery packs safe and secure
- Jumper wires for making additional connections

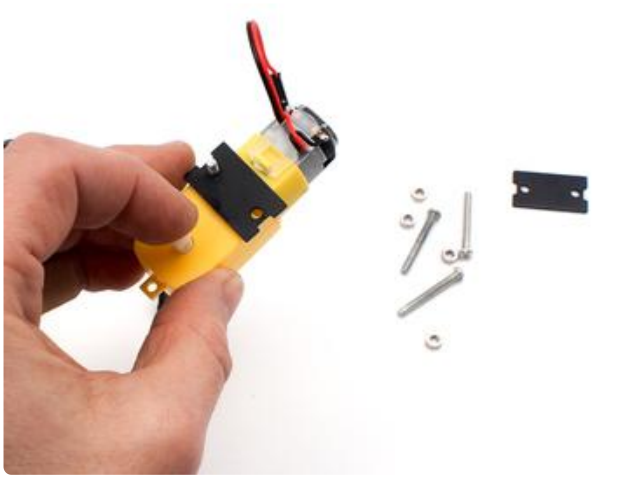
Assembling and Wiring Your Mini Race Car

The wiring and assembly is pretty easy, and there is no soldering required! You'll just need the small screwdriver that came in the kit, and it wouldn't hurt to grab some pliers. (It'll make it faster and easier to put together)

First, you'll assemble the robot chassis. All the parts needed for this are inside the brown box with the 'Custom Black 2WD Robot + extra layer' sticker on it.

Motors and Wheels and Tires





To start, take the two motors, four long screws, four nuts, and two black panels.

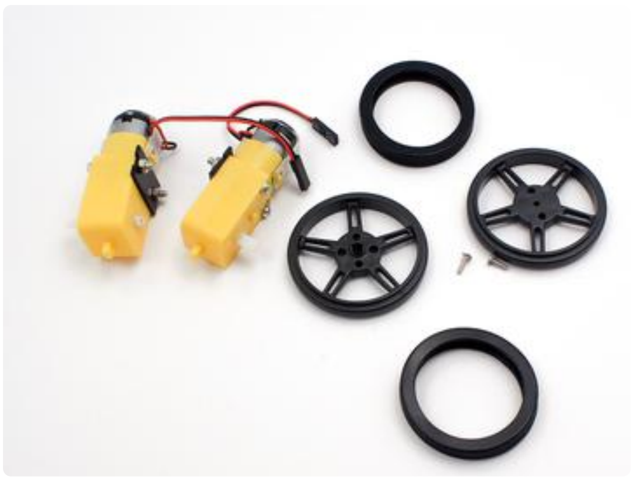
Screw the two black panels onto the motors.

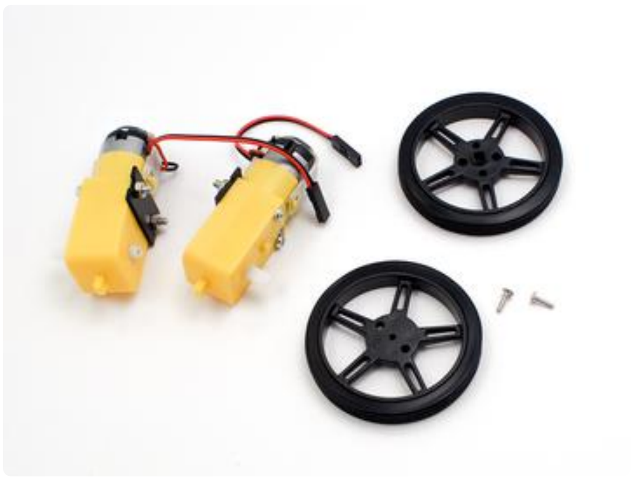
The metal panels go on the side with the red and black wires coming out.

Have the hex nuts on the metal panel side so they don't interfere with the wheel!

The metal panels go on the side with the red and black wires coming out.

Have the hex nuts on the metal panel side so they don't interfere with the wheel!

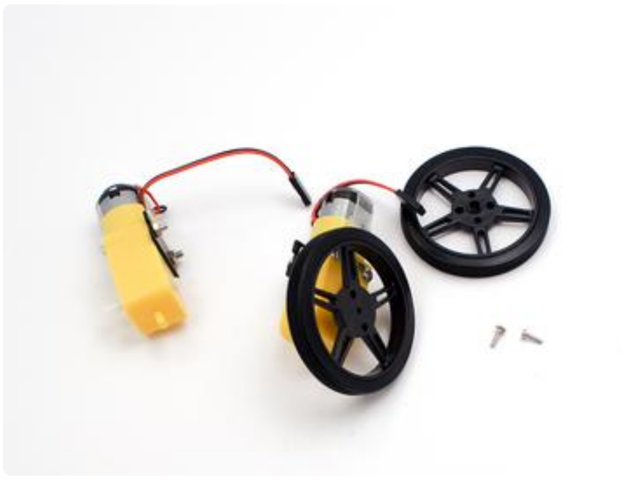


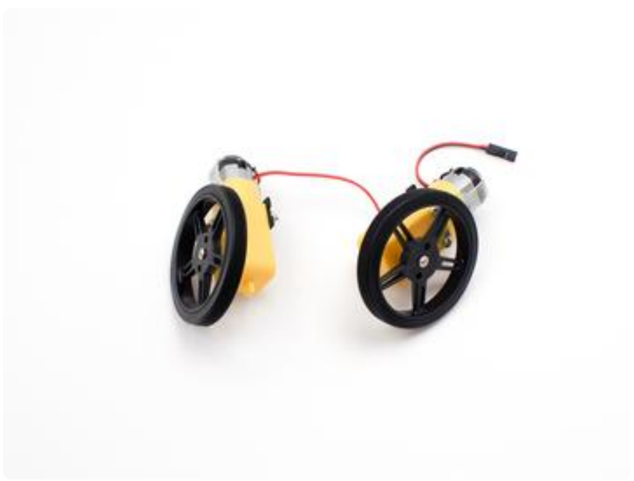


Take the two wheels, rubber treads, and 2x small screws found in the same bag as the wheels.

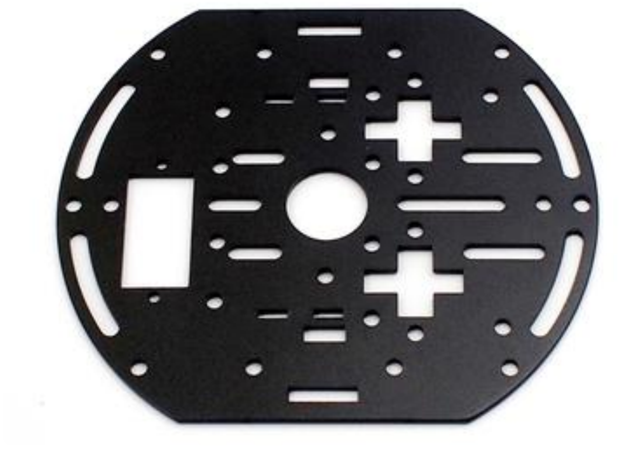
Put the rubber treads on the wheels. This is a lot of fun!

Fit the wheels onto the white knob on the motors, they will snap nicely onto the oval center.



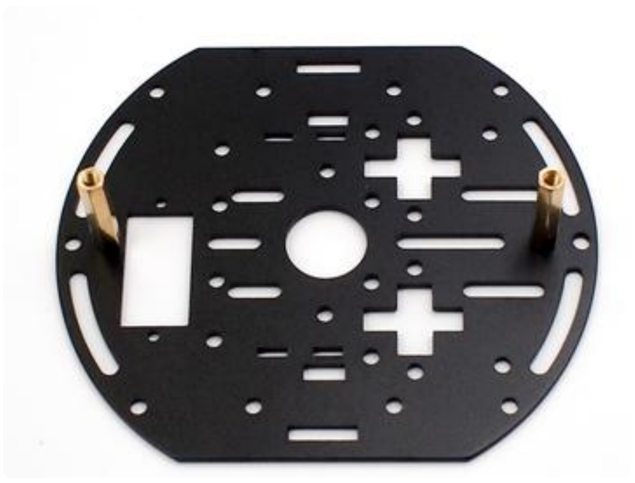


Lower Chassis



Take one of the black chassis layers. All three layers are identical.

Align it on your table as shown on the left. Note that the panel is not symmetrical - look on the left to see that rectangle cut out? Make sure it's aligned as you see here!



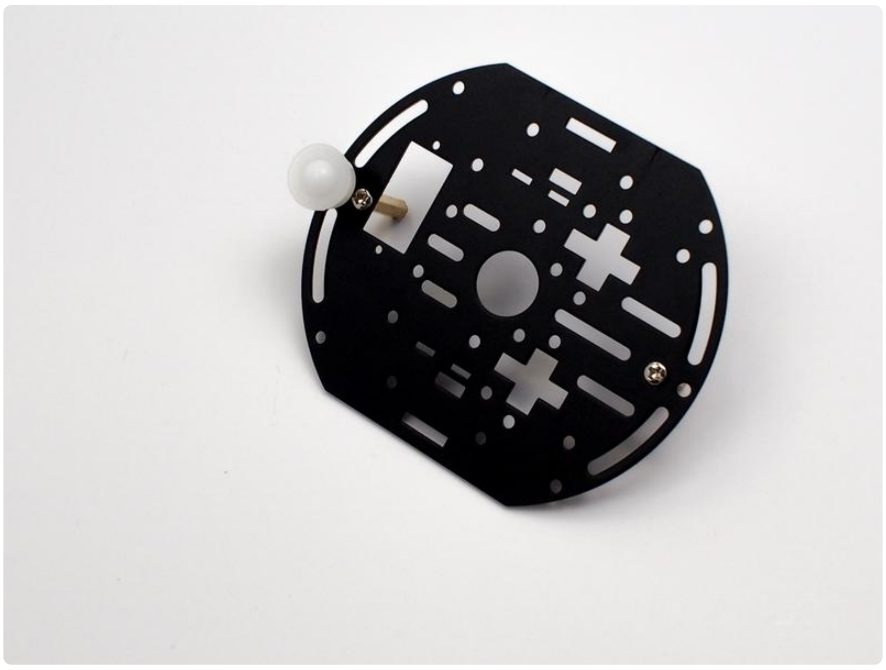
Attach two of the brass standoffs onto the black chassis layer.

The standoffs should be screwed into the second set of holes from the outer edge - meaning the two interior holes.

Turn over the plate

Attach the white free-wheel into the exterior hole closest to the rectangular opening.

The white free-wheel should be on the opposite side of the chassis of the standoff.

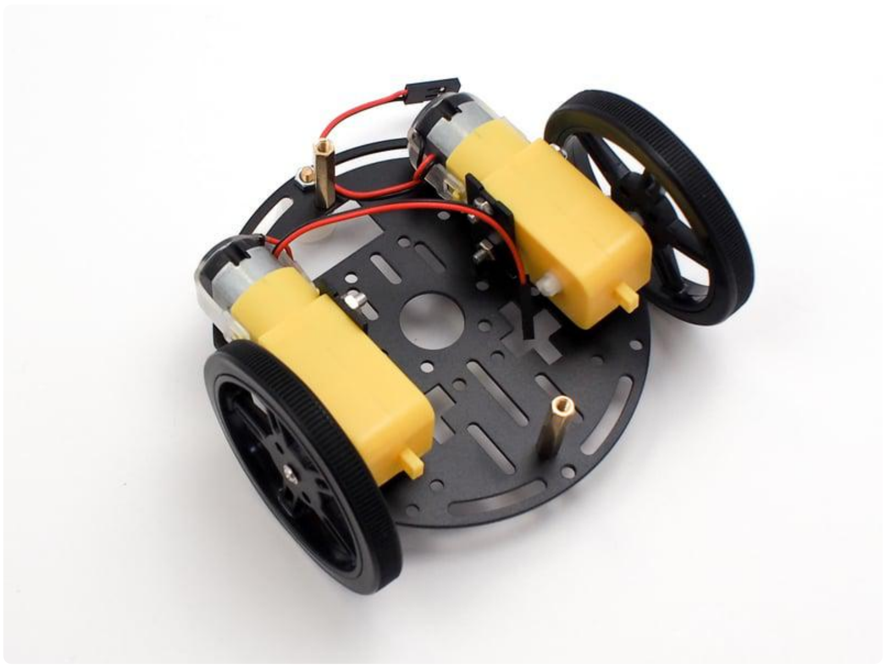


Turn over the plate again

Take your assembled wheels and fit them into the chassis layer.

There are 2 slots on the black panels that you attached to your motor that should fit perfectly into the chassis layer.

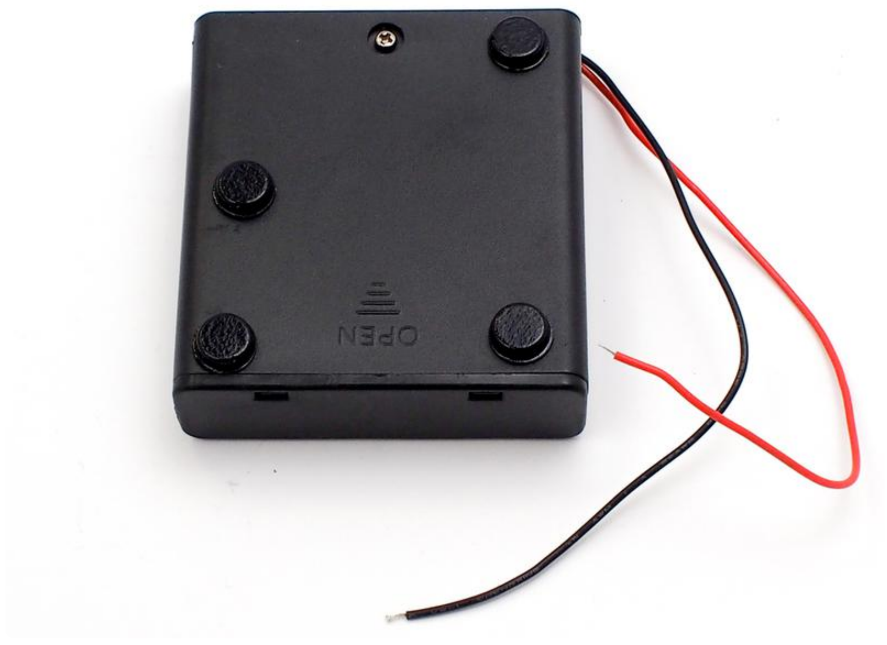
The metal front of the motor will be pointing toward the side of the chassis where you placed your white freewheel



Prepare the Battery Box

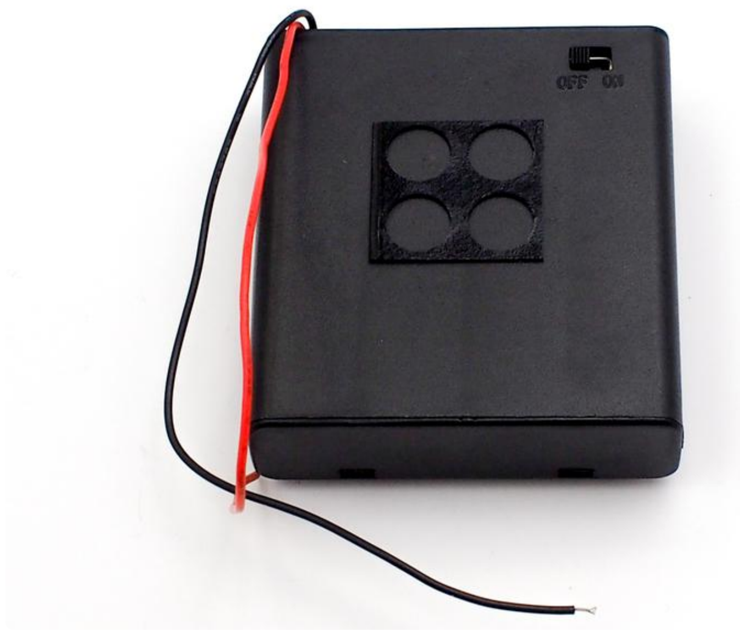
For this step, you will need the AA battery box, 4 x AA batteries, the screwdriver, and a sheet of 4 rubber bumpers.

First, open each battery box, grab out the screw, insert your batteries, and then screw the boxes shut. Oh, and make sure you have the boxes switched to the off position. Now, take the 4 rubber bumpers and place them as shown in the picture below. Notice how the one bumper on the left side is not in the upper left corner. Important: don't throw away the leftover piece of bumper material, we are going to use that on the next step.

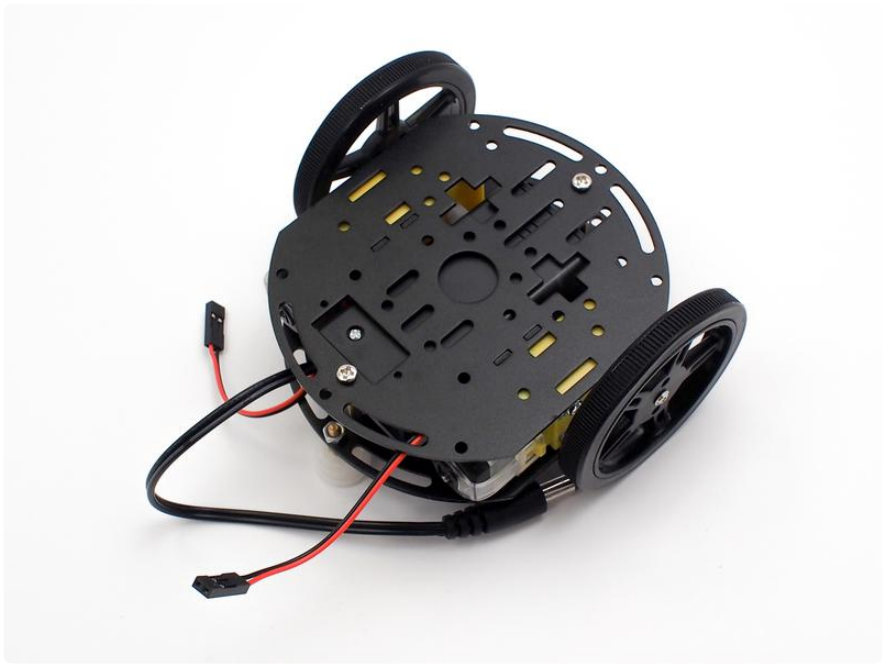


Do not discard the leftover piece of bumper material.

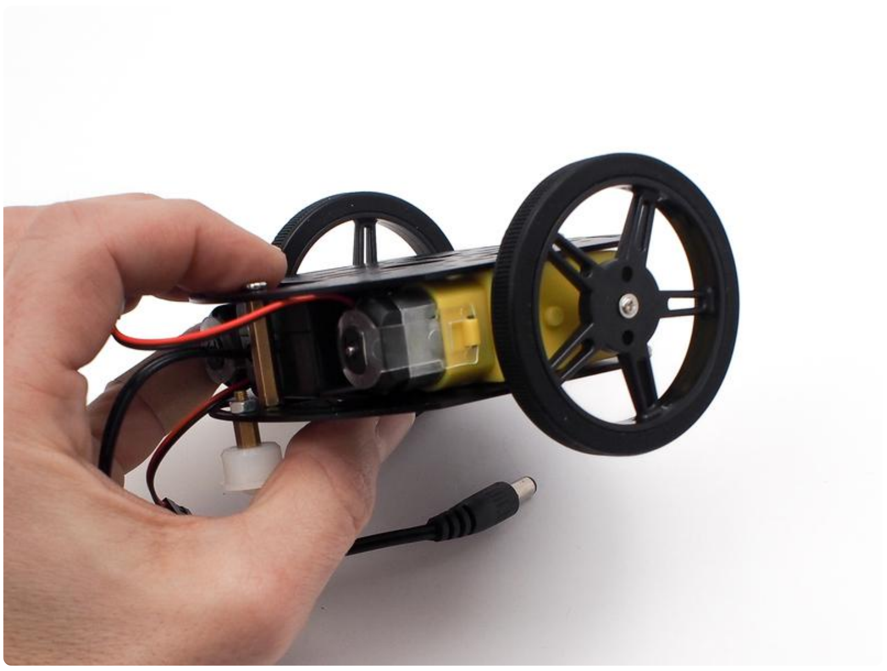
Flip the battery box over and place the scrap piece of the bumper material in the middle. This will help hold the battery box nice and tight between the top and middle plate of your robot.

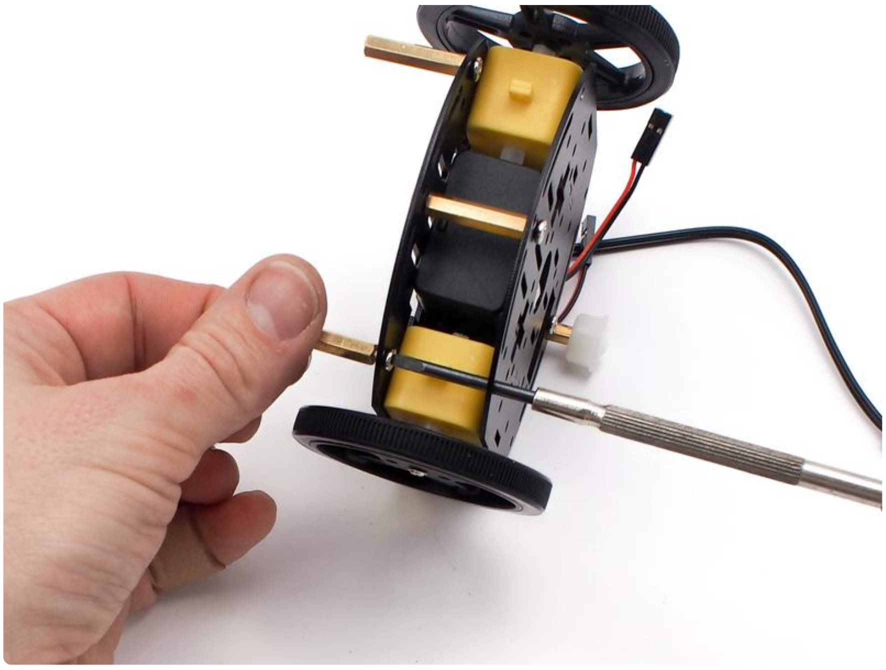


Middle Chassis Layer

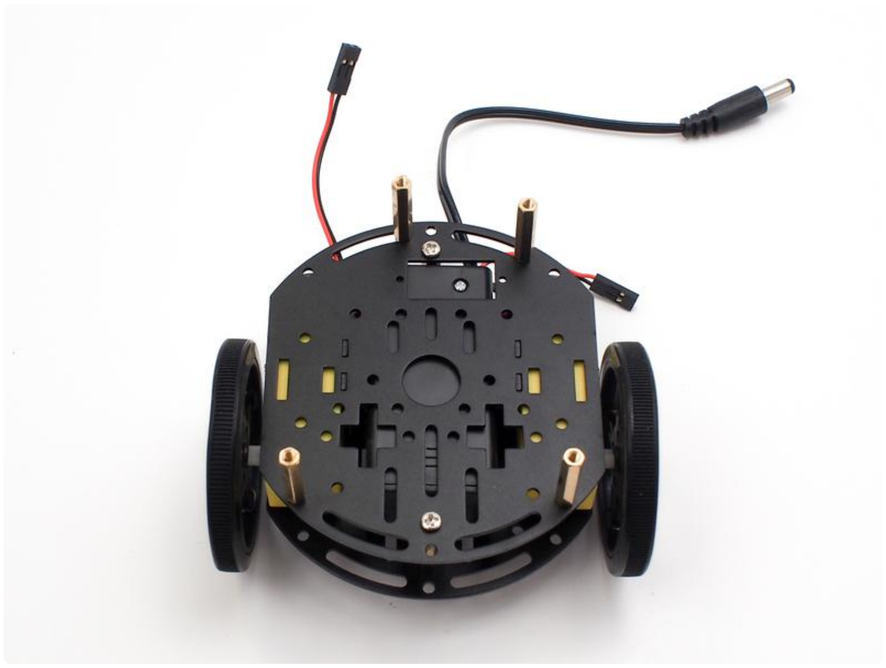


Place the middle chassis layer onto robot, making sure to fit the motor tabs into the slots of the layer, then screw in the two brass standoffs.

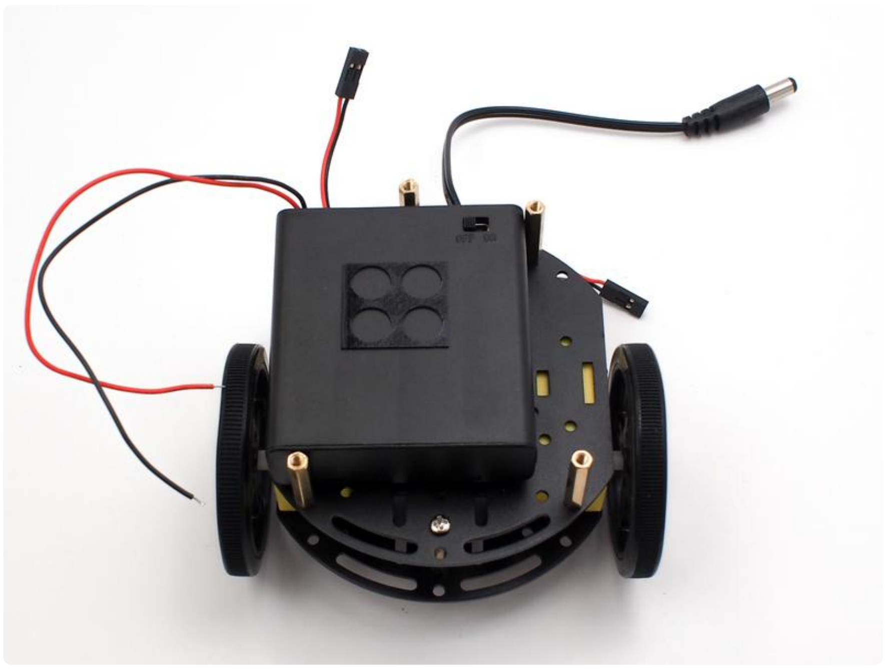




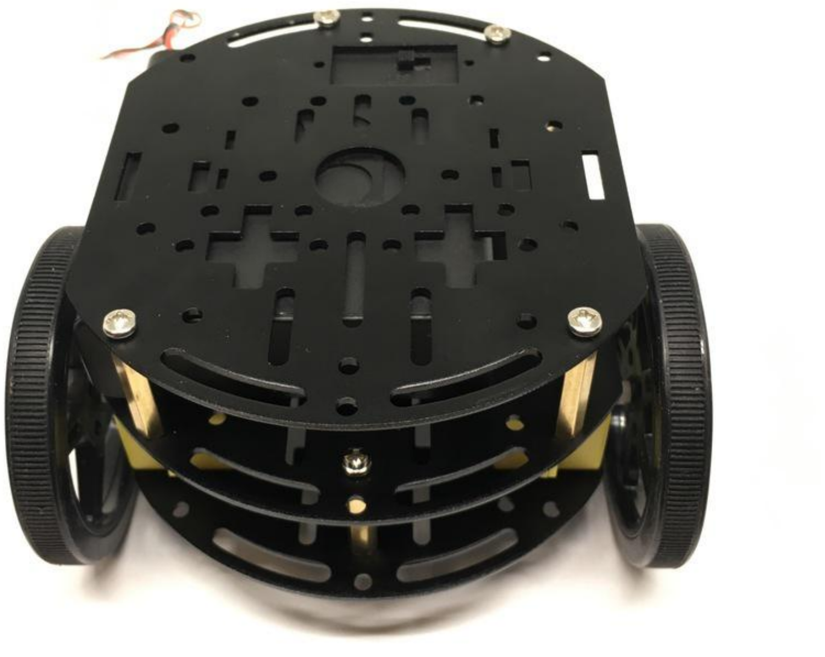
Take a look at the image below and install the brass stand-offs in the same positions. You can insert the stand-off screws through the middle plate and hand tighten the stand-offs while putting a bit of pressure on the screw with your finger. Or, as a tip, you can screw in the stand-off screws with the flat end of the screwdriver, which can reach through the holes in the bottom plate.



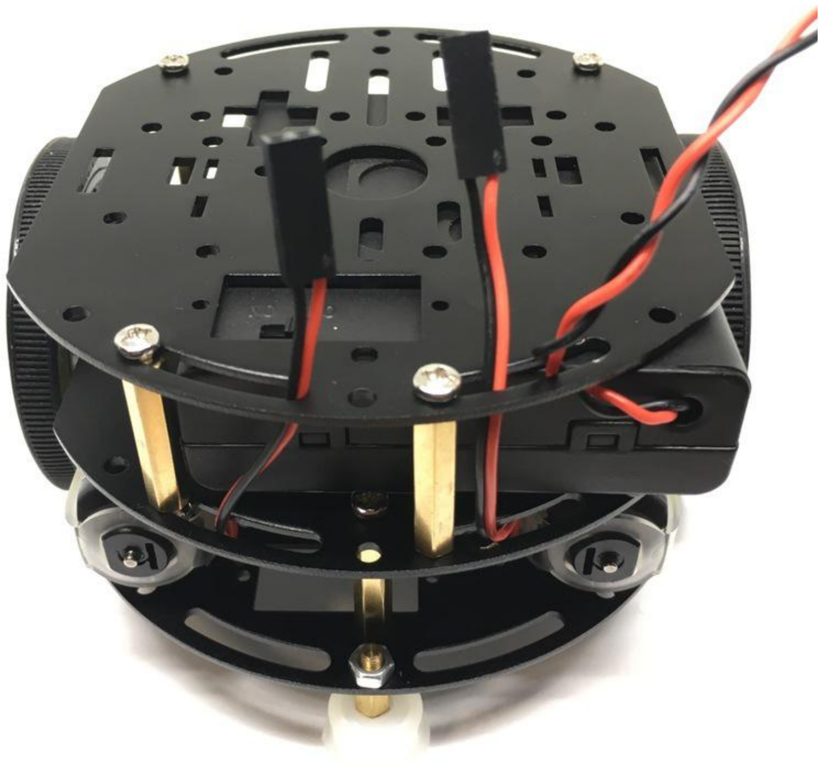
Once you have the stand-offs in place as shown in the image above, let's place the battery box in the correct spot as shown in the image below.



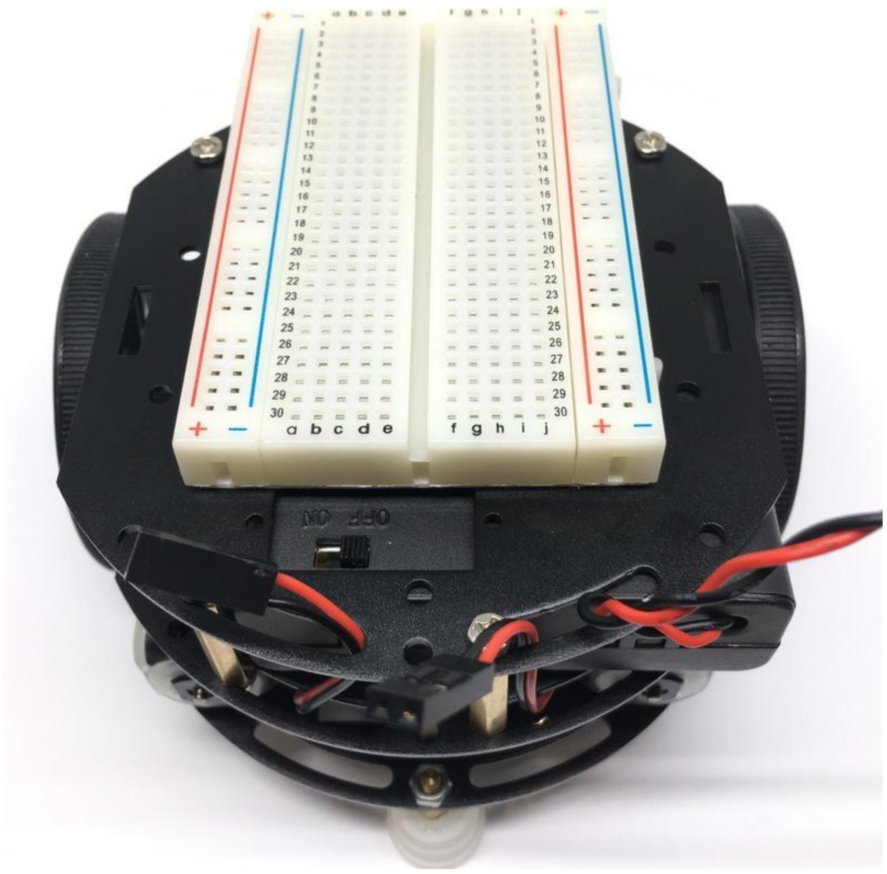
Notice the battery box is lined up on the left side of the middle chassis plate. It should be just in-between the upper left stand-off and the lower left stand-off (not touching either). This will make sure the on-off switch lines up just right in the hole of the top plate. Go ahead and install the top plate now as shown here.



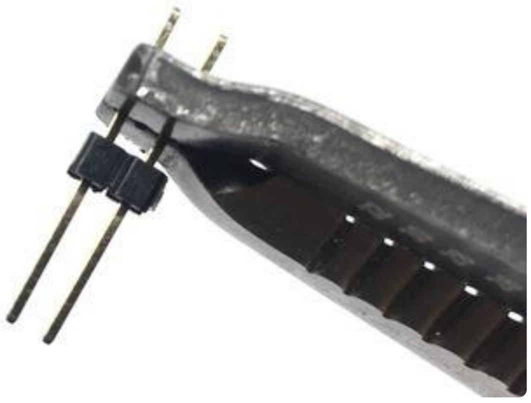
See how the on-off switch is now accessible through the top plate? Now let's take just a minute to route the wires from the motors and the battery box through the chassis like shown in the image below.

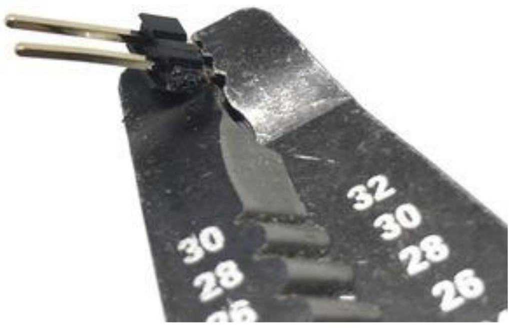


We are getting close! Now let's install the breadboard on top of the robot. Peel off the backing from the foam sticker on the bottom of the breadboard. Take a look at the image below and stick it exactly as shown. Be sure to install the breadboard just as shown in the image below and not sideways or the motor wires won't reach the motor driver Feather Wing.



Prepare the Electronics



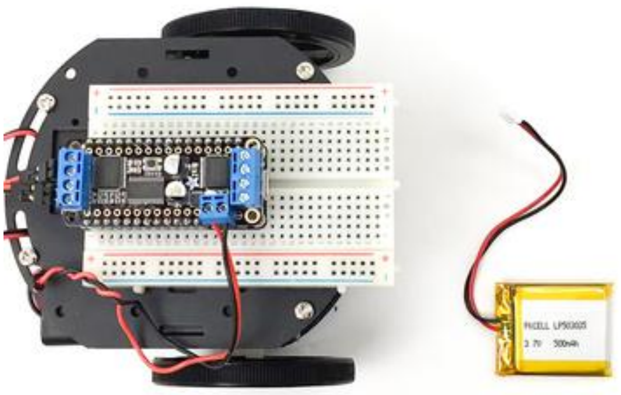


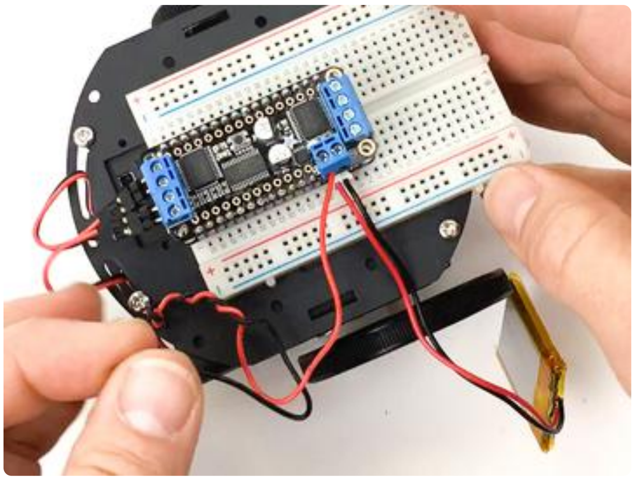
For this next step, a pair of pliers is handy. First, grab the 6 header pins all attached together and break them into 3 sets of 2 header pins. Then, grab them in the pliers like shown here, and then slightly bend them so they look like the next picture.

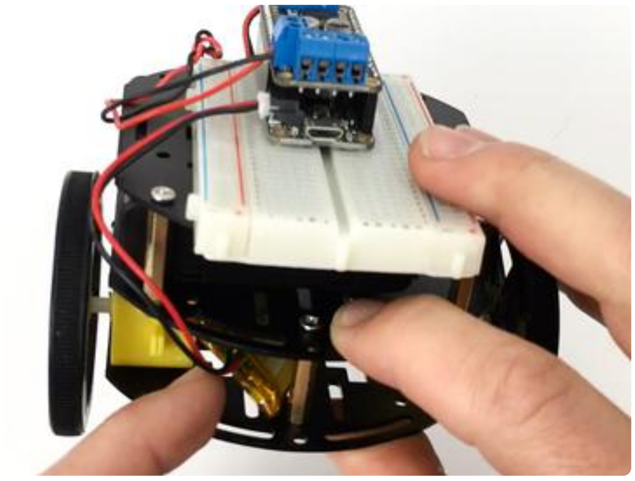
If you don't have pliers you can do it with your fingers (carefully!)

With the breadboard in place, go ahead and grab your stacked Bluefruit Feather, and Motor Driver FeatherWing and install it in the breadboard with the USB port facing away from the wires like shown in the image below. Then use your screwdriver and install the bent header pins like shown in the image. Finally, attach the motor wires and power wires as shown in the image. It is important that you have the red and black wires in the correct position. Please reference the image below and triple check that they are installed correctly.

LiPoly Battery

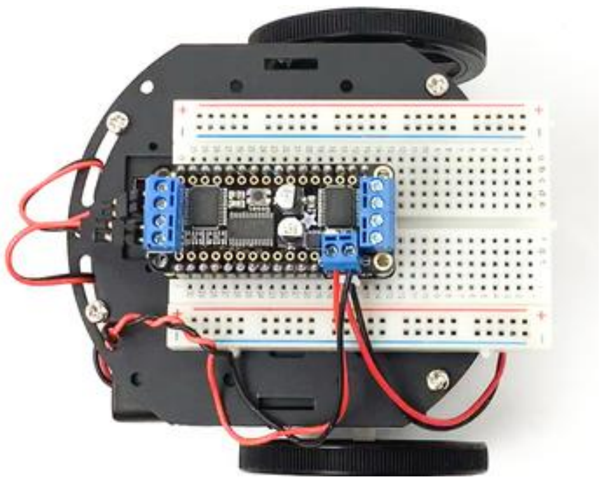




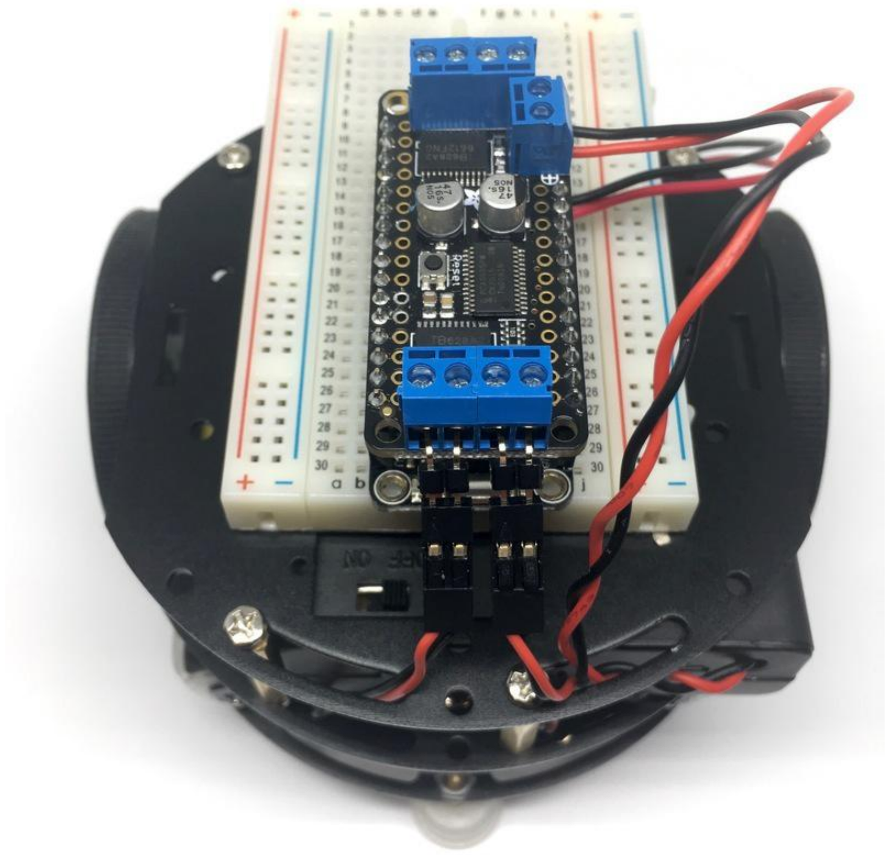


The AA batteries will supply power to the motors through the Motor Driver FeatherWing, but what about power for the Feather itself? For that, you'll use a LiPoly battery. It's small, powerful, and very convenient -- you can charge it simply by plugging the Feather into a USB charger!

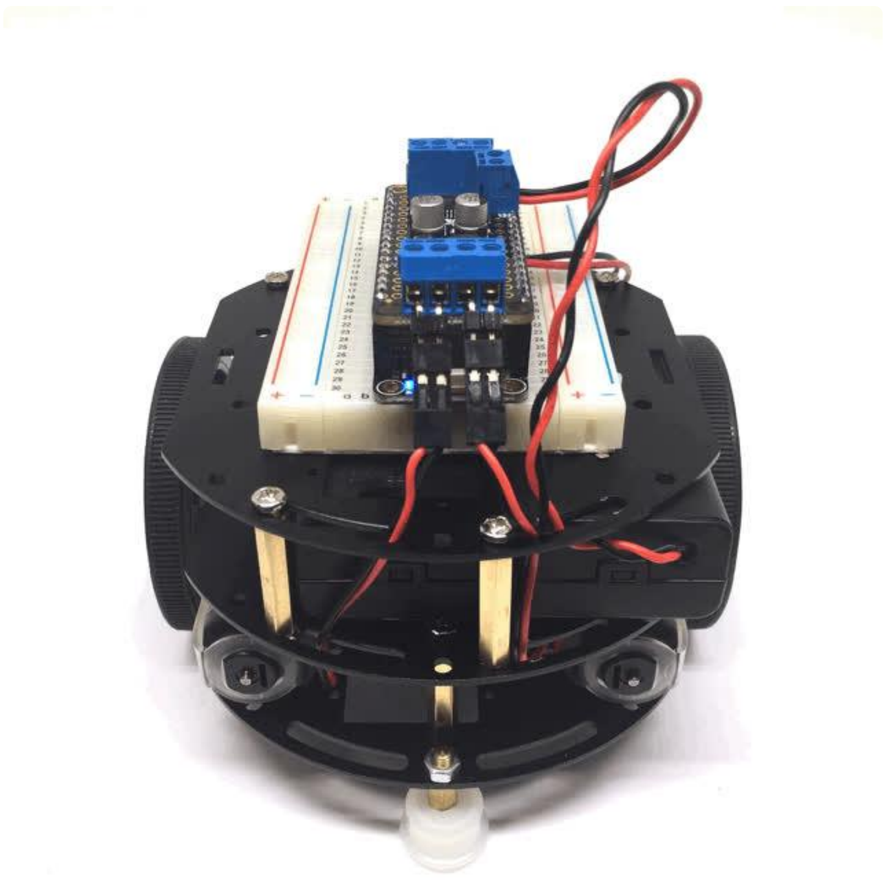
Plug the LiPoly battery into the JST battery port on the Feather, and then tuck the battery into the space in the lower level of the robot. If you like, you can secure it with double stick foam tape.



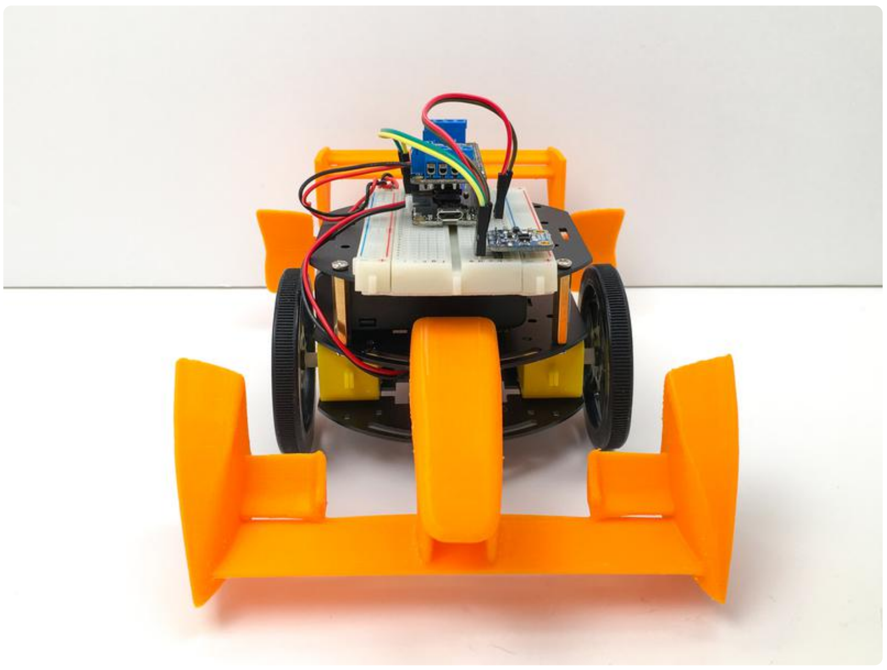
Congratulations, you've built your robot!



That's it for the first part of getting your robot assembled and wired. Now, let's get this robot moving! On to the code!

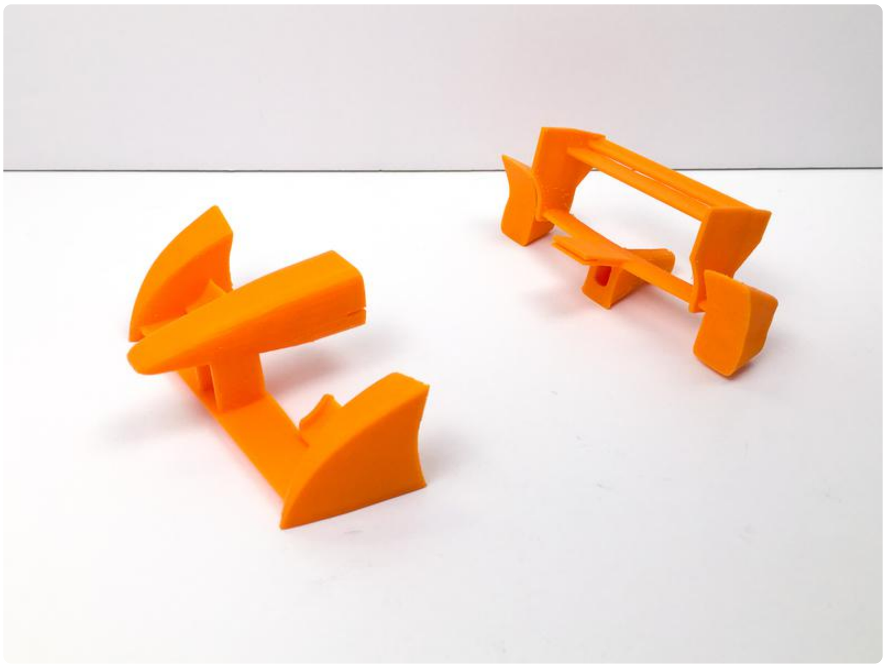


3D Printed Car Parts



Bonus Body Parts

Want to dress your race car up to look like its Formula E bigger siblings? Add a 3D printed nose and tail to your mini race car! You can imagine how these wings provide all the downforce needed to keep a real Formula E car stable and provide the downforce to prevent lift off!

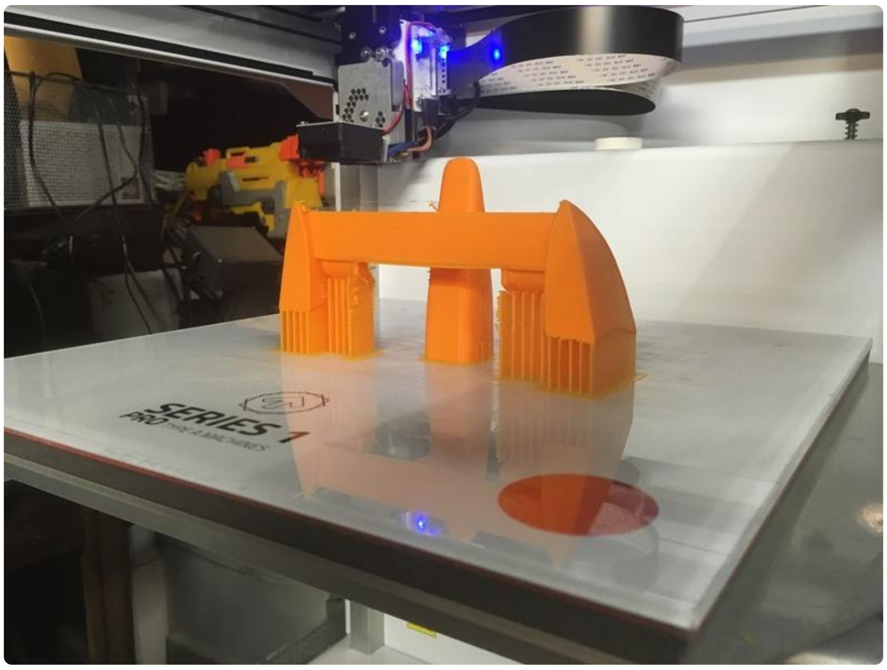


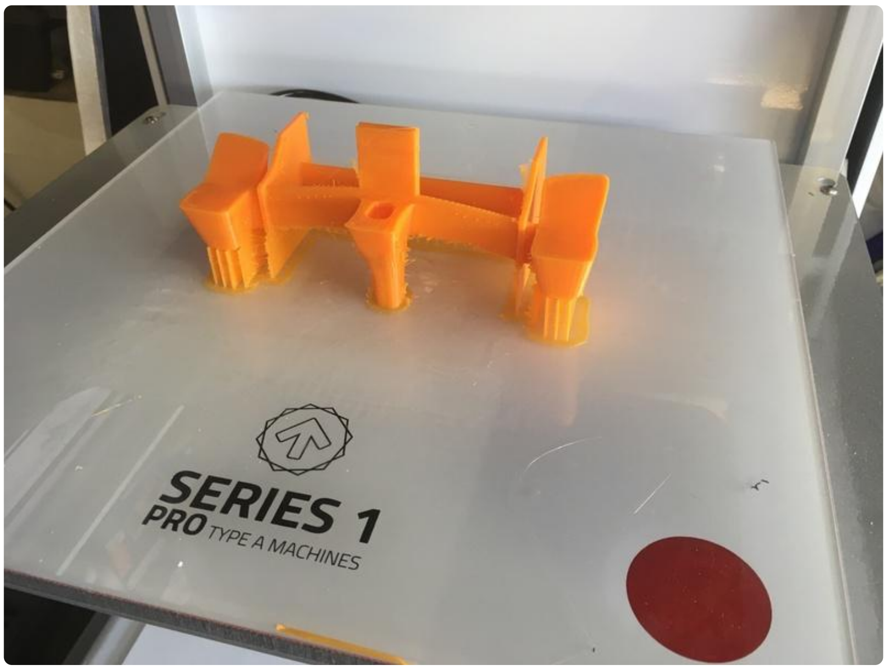
These models are based on the excellent Formula E Race Car model by petropixel () published on Thingiverse under Creative Commons license.

I designed the new parts to be printed vertically (nose up for the front piece, tail down for the back piece) and they each have a groove that can be used to press fit them onto the race car's middle plate.

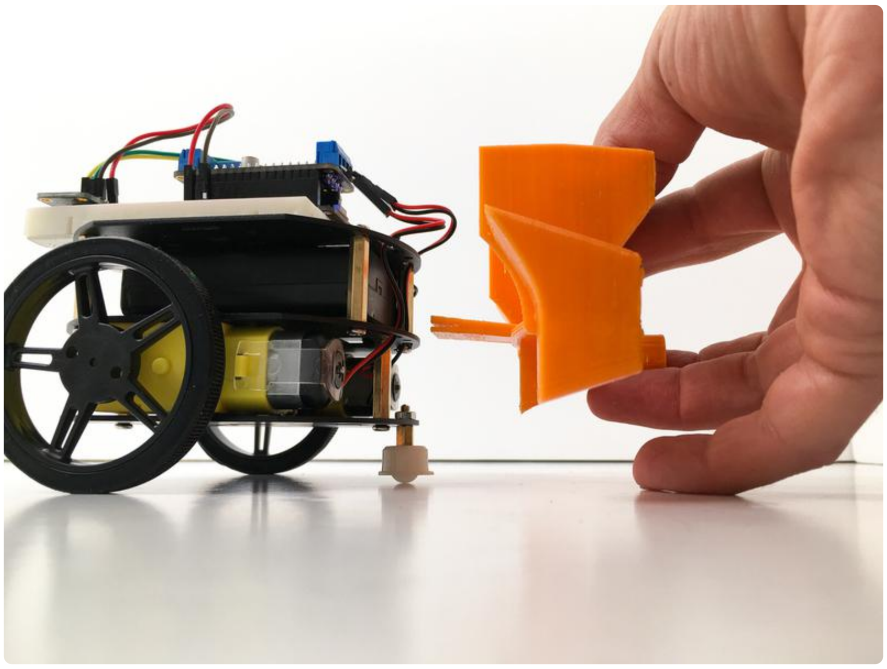
You can download the model files here, and then either print them on your own 3D printer, or send them to a service, such as 3D Hubs, to have them printed for you.

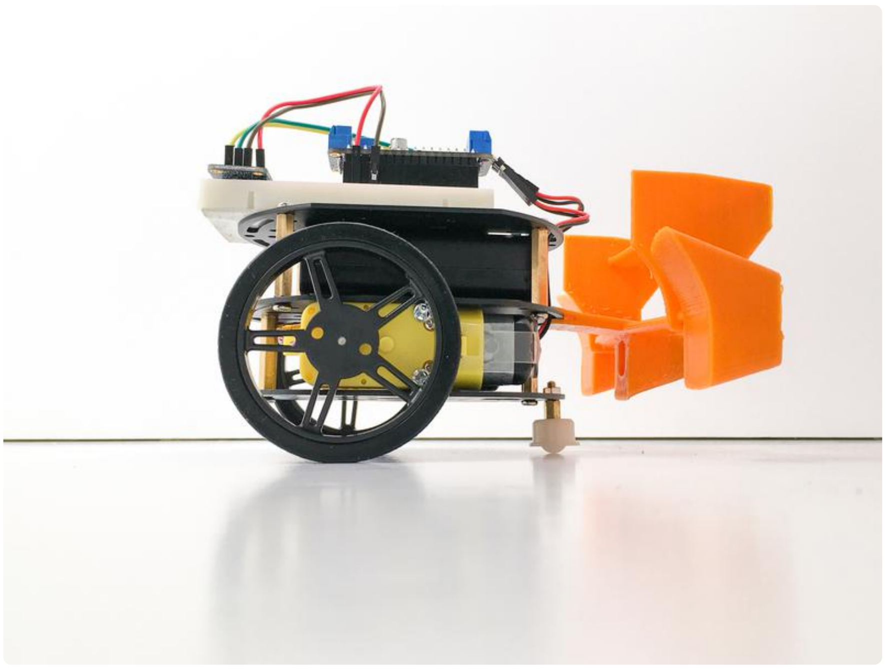
formulaEParts.zip

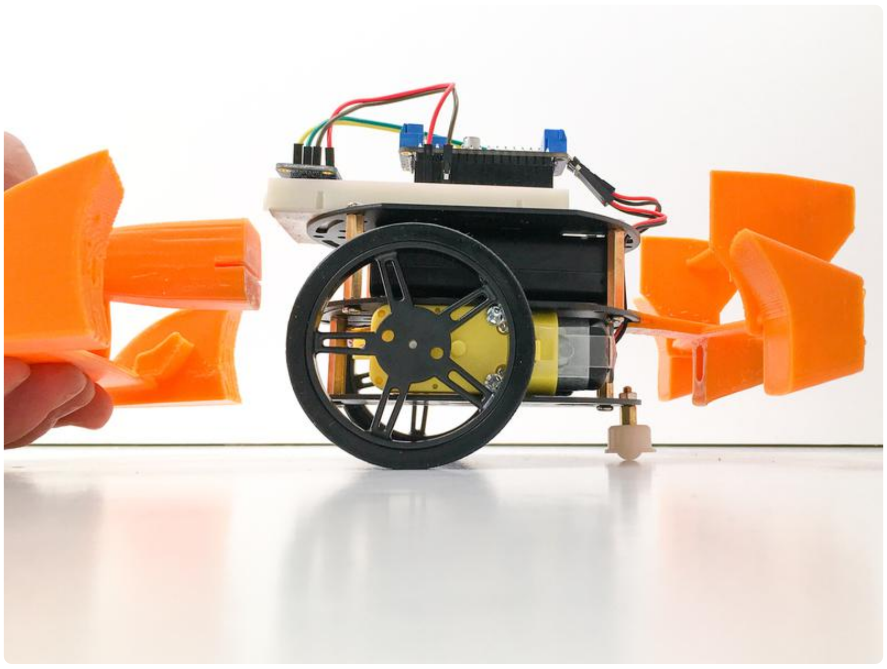

SERIES 1
PRO TYPE A MACHINES

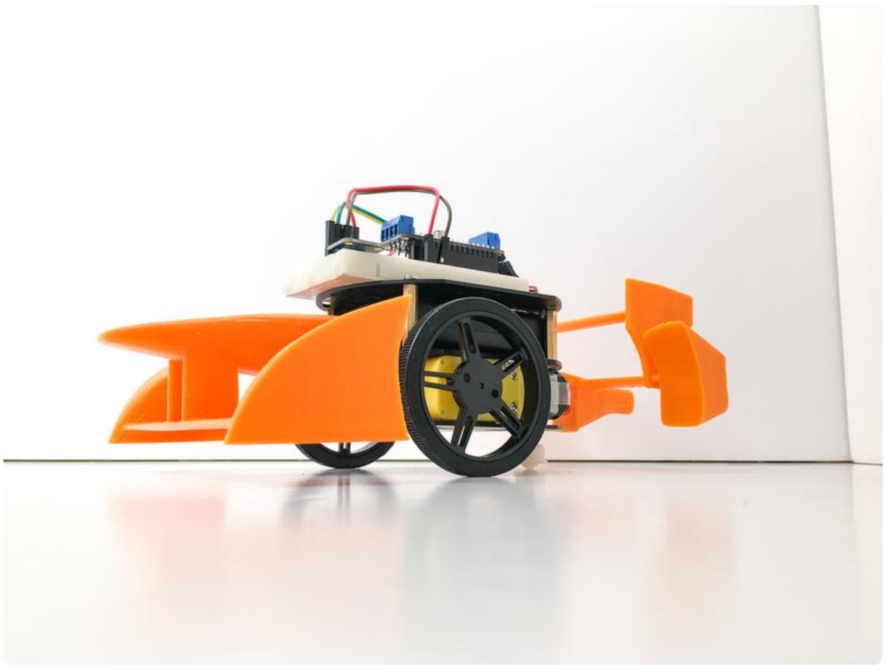

SERIES 1
PRO TYPE A MACHINES

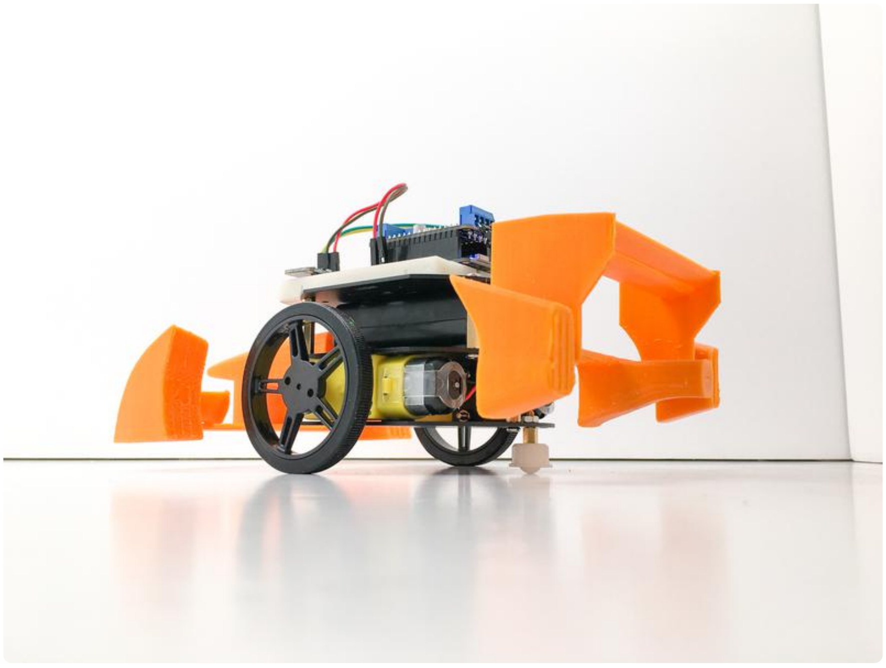
Once they're done printing, clean off any support material, and then fit them onto the racer's middle plate.

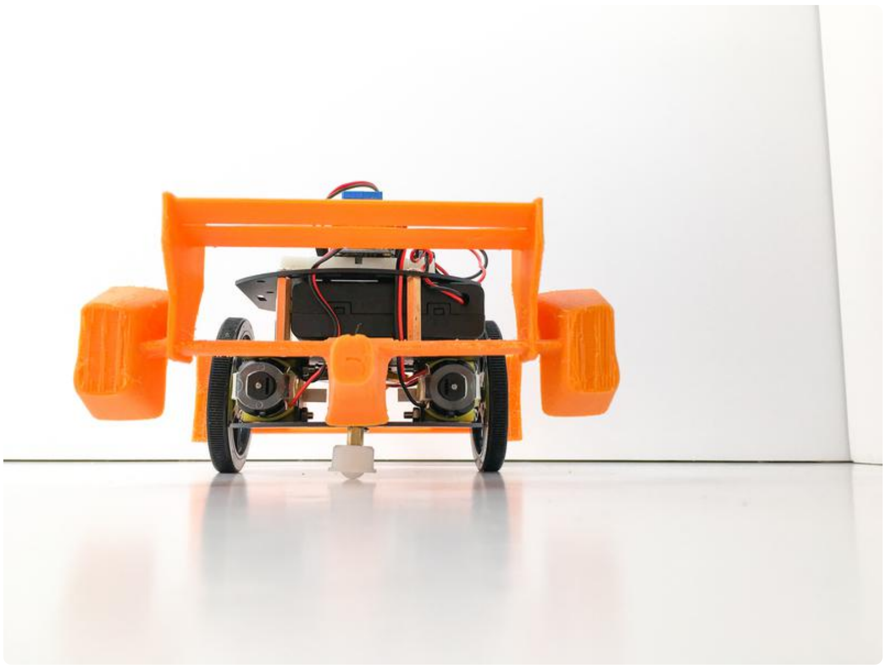


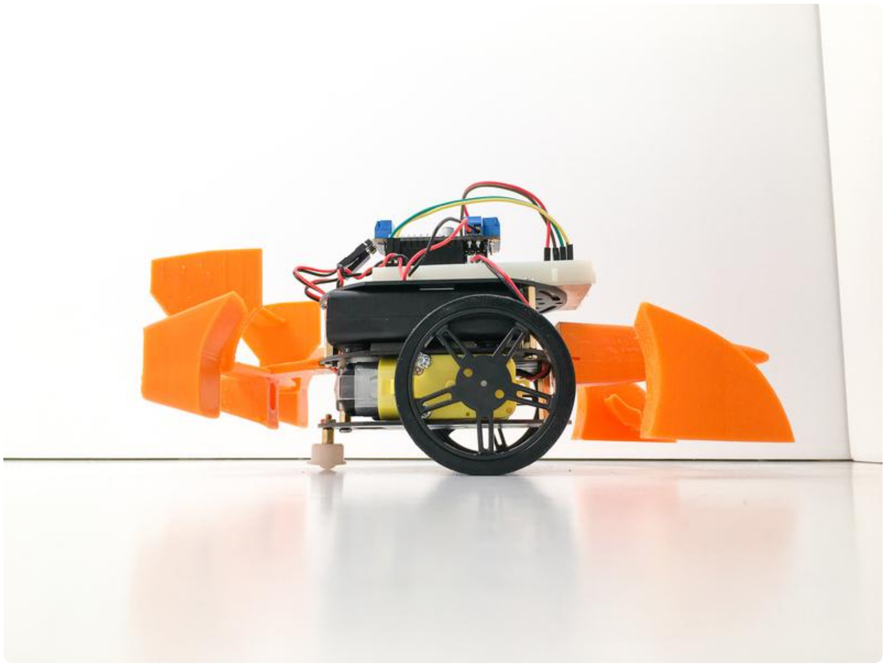


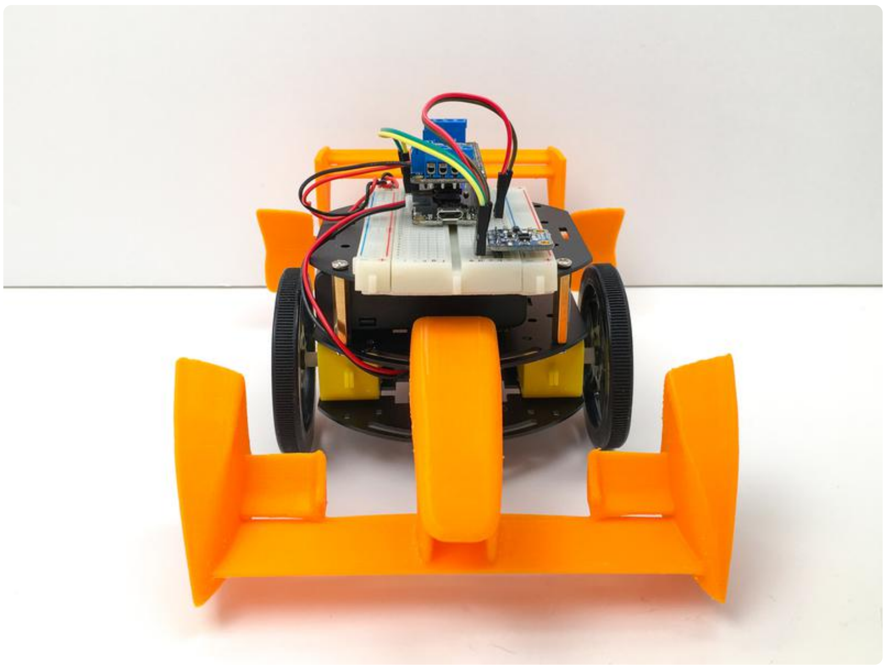












How Your Race Car Works: The Basics

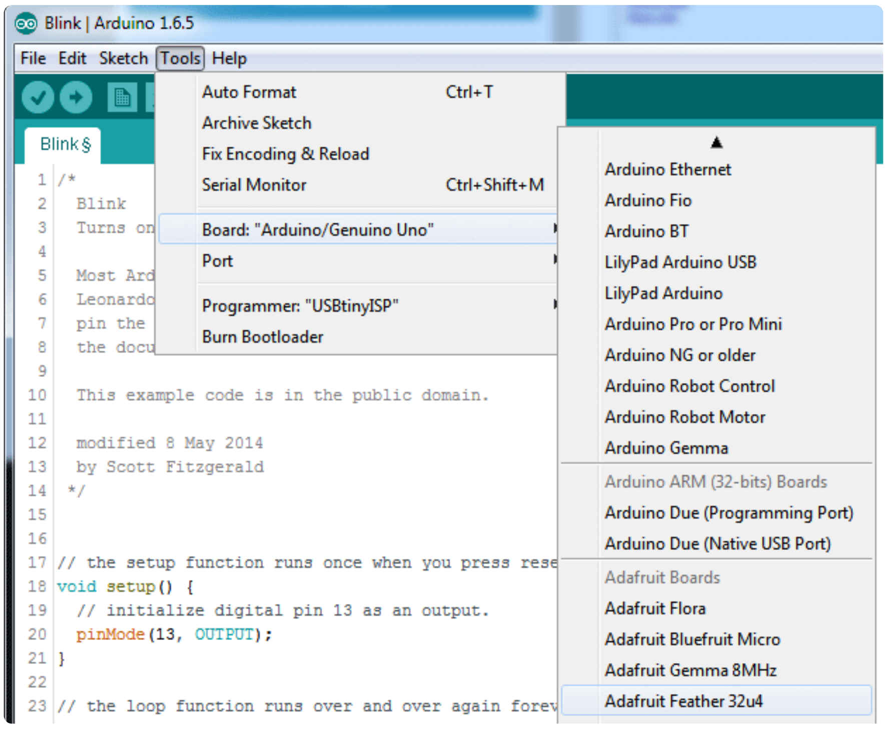
Before we dig into the more complicated code, let's take a minute to break down the simple motor controller code, and how it works to control your robot's motors.

Before going any further, make sure you have a basic understanding of how to program and use an Arduino-compatible Feather microcontroller. Thankfully, we have a lot of great tutorials on how this whole thing works. Click here to get started with Arduino (), and then come back to this guide to continue.

Before going any further, make sure you have a basic understanding of how to program and use an Arduino

Board Support Package and Drivers

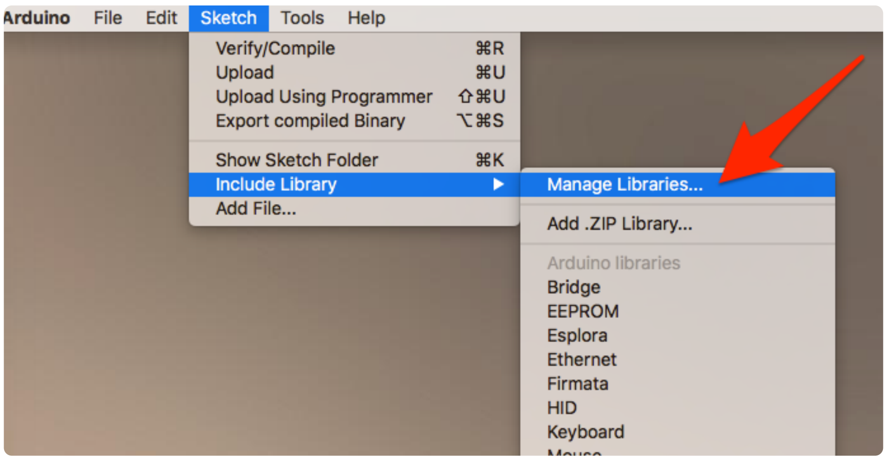
For the Feather 32u4, check out the guide for how to install Arduino IDE & add Adafruit Board () support, then install Feather Board support ()



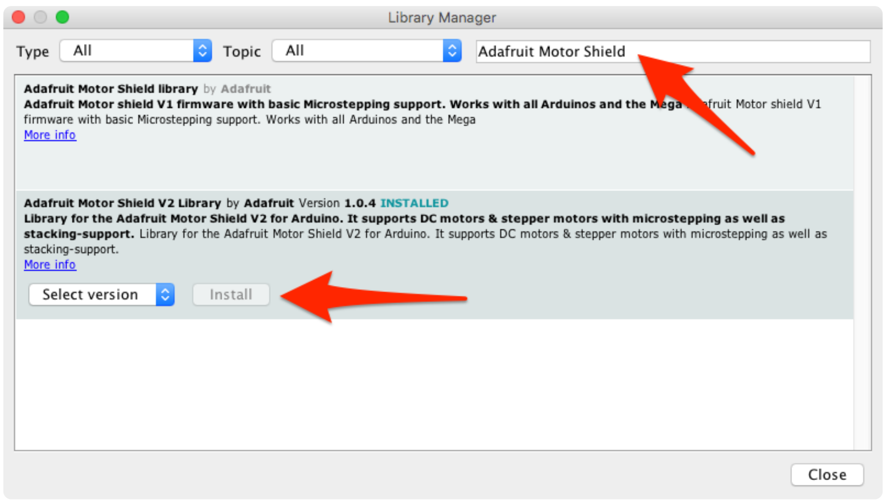
```
/*
  Blink
  Turns on

  Most Ard
  Leonardo
  pin the
  the docu

  This example code is in the public domain.

  modified 8 May 2014
  by Scott Fitzgerald
 */


// the setup function runs once when you press rese
void setup() {
  // initialize digital pin 13 as an output.
  pinMode(13, OUTPUT);
}

// the loop function runs over and over again forev
```

Libraries

For your robot to work correctly, you will need to install a couple libraries. To install the libraries, we will use Arduino's handy library manager. Navigate to the library manager like shown in the screenshot below.



Then, all you need to do is search for the library you want to install. For this mini race car, start by searching for 'Adafruit Motor Shield', you should see two options like this:



Adafruit Motor Shield library by Adafruit
Adafruit Motor shield V1 firmware with basic Microstepping support. Works with all Arduinos and the Mega [illegible]afruit Motor shield V1 firmware with basic Microstepping support. Works with all Arduinos and the Mega
More info

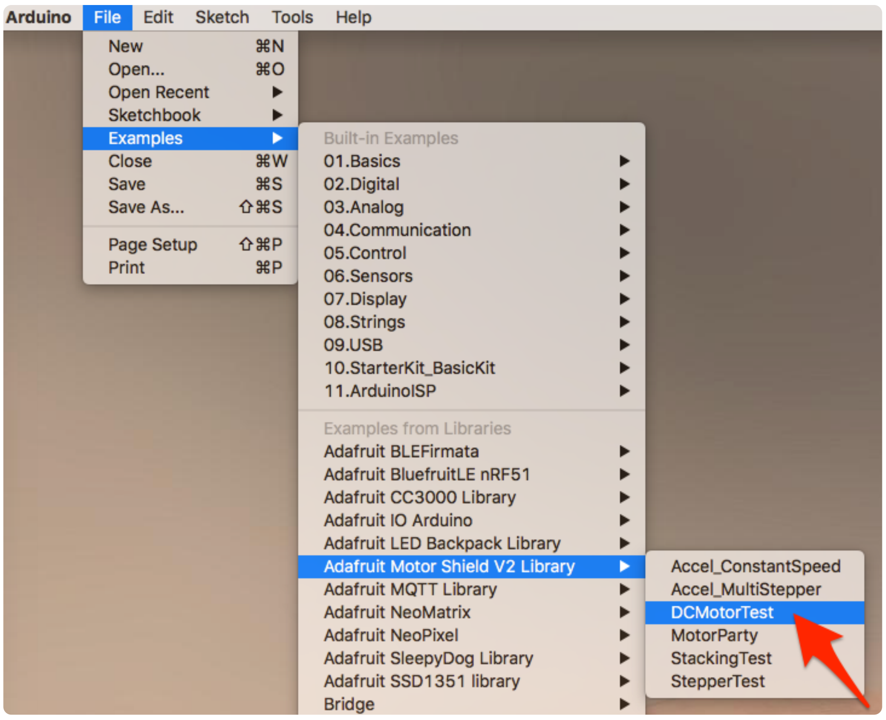
Adafruit Motor Shield V2 Library by **Adafruit** Version **1.0.4** **INSTALLED**
Library for the Adafruit Motor Shield V2 for Arduino. It supports DC motors & stepper motors with microstepping as well as stacking-support. Library for the Adafruit Motor Shield V2 for Arduino. It supports DC motors & stepper motors with microstepping as well as stacking-support.
More info

Under the Adafruit Motor Shield V2 Library, select the latest version from the dropdown, then click the install button.

While we won't need it quite yet, you might as well go ahead and search for 'Adafruit BluefruitLE nRF51', and install the latest version of that. We will use this library later on.

DC Motor Test

Now that you have the libraries installed, let's open up the example sketch to try out the DC motors on your car. You can find the example sketch in the Arduino Examples menu:



Take a look through this example sketch. Before you upload the code and run it on your robot, you need to make a change or two. First off, you will need to change what port the motors are connected to. Let's start by just trying one of the motors. If you remember when we assembled the robot, we connected the motors to the back of the motor shield, in ports M3, and M4. So, in the top part of the code, go ahead and change out the port from 1, to 3 like this:

```
// Select which 'port' M1, M2, M3 or M4. In this case, M1
Adafruit_DCMotor *myMotor = AFMS.getMotor(3);
// You can also make another motor on port M2
//Adafruit_DCMotor *myOtherMotor = AFMS.getMotor(2);
```

When you see two forward slashes // in front of text, that is called commenting. Anything written after the // will be ignored by the Arduino. It is a way to communicate with whomever is reading your code.

Place your car on top of a cup or mug so the wheels are not touching the ground. Select Adafruit Feather 32u4 as the board under the Arduino Tools menu, and upload this code to your Feather through the USB connector.

Notice how just the one wheel is going forward, then backward. If you update the code to this:

```
// Select which 'port' M1, M2, M3 or M4. In this case, M1
Adafruit_DCMotor *myMotor = AFMS.getMotor(4);
// You can also make another motor on port M2
//Adafruit_DCMotor *myOtherMotor = AFMS.getMotor(2);
```

With the motor port changed to 4, the other motor should now run. That is really the basics of how we will go about controlling the race car.

Let's Get Moving

Now that you know how to make either motor go forward and backward with the example sketch, let's learn the rest of the motor controller basics and write a sketch to get this robot moving. At the top of your sketch, you just need to call out both motors. To do this, you just need to uncomment the `myOtherMotor` line of code by removing the two forward slashes before the code. Then, set the second motor to 3 like so:

```
// Select which 'port' M1, M2, M3 or M4. In this case, M1
Adafruit_DCMotor *myMotor = AFMS.getMotor(4);
// You can also make another motor on port M3
Adafruit_DCMotor *myOtherMotor = AFMS.getMotor(3);
```

In this case, we have myMotor set to M4, which is our right side motor, and myOtherMotor is set to M3, our left side motor.

Using the names myMotor, and myOtherMotor makes things really hard for us to remember which motor is which. So, we can simply change the variable name to whatever we want. Let's simply call them leftMotor, and rightMotor like this:

```
// Set up the left motor on port M4
Adafruit_DCMotor *leftMotor = AFMS.getMotor(4);
// Set up the right motor on port M3
Adafruit_DCMotor *rightMotor = AFMS.getMotor(3);
```

Of course, now that we have changed the variable name, we need to replace any instance of `myMotor` with `leftMotor`, and `myOtherMotor` with `rightMotor`.

Before we start driving forward, backward, or turning; we need to tell the motor controller how fast we want the motors to go. This is done using the `setSpeed` function. If we want to make both motors go full speed ahead, we would set them both to 255 like this:

```
// Set the speed to start, from 0 (off) to 255 (max speed)
  leftMotor-&gt;setSpeed(255);
  rightMotor-&gt;setSpeed(255);
```

To make your robot go forward, all we need to do is tell each motor to go forward like this:

```
leftMotor-&gt;run(FORWARD); //LEFT MOTOR FULL STEAM AHEAD!
rightMotor-&gt;run(FORWARD); //RIGHT MOTOR FULL STEAM AHEAD!
```

All right, let's put this into a full sketch and give it a shot. For this sketch, Go ahead and upload this sketch to your robot. I have slowed down the speed for safety, but you can update to whatever you want. Even though it is slowed down, don't forget to set your race car on a mug or a cup to keep the wheels off the ground.

```
/*
This is a test sketch for the Adafruit assembled Motor Shield for Arduino v2
It won't work with v1.x motor shields! Only for the v2's with built in PWM
control

For use with the Adafruit Motor Shield v2
----&gt;http://www.adafruit.com/products/1438
*/

#include &lt;Wire.h&gt;
#include &lt;Adafruit_MotorShield.h&gt;
#include "utility/Adafruit_MS_PWMServoDriver.h"

// Create the motor shield object with the default I2C address
```

```
Adafruit_MotorShield AFMS = Adafruit_MotorShield();
// Or, create it with a different I2C address (say for stacking)
// Adafruit_MotorShield AFMS = Adafruit_MotorShield(0x61);

// Set up the left motor on port M4
Adafruit_DCMotor *leftMotor = AFMS.getMotor(4);
// Set up the right motor on port M3
Adafruit_DCMotor *rightMotor = AFMS.getMotor(3);

void setup() {
  Serial.begin(9600);           // set up Serial library at 9600 bps
  Serial.println("Adafruit Motorshield v2 - Robot Test!");

  AFMS.begin();  // create with the default frequency 1.6KHz
  //AFMS.begin(1000);  // OR with a different frequency, say 1KHz
}

void loop() {
  // Set the speed to start, from 0 (off) to 255 (max speed)
  leftMotor-&gt;setSpeed(100);
  rightMotor-&gt;setSpeed(100);

  leftMotor-&gt;run(FORWARD); //LEFT MOTOR FULL STEAM AHEAD!
  rightMotor-&gt;run(FORWARD); //RIGHT MOTOR FULL STEAM AHEAD!
}
```

Is your race car still not going forward? Be sure to flip the switch on your battery box to 'on'

Ok, so we have the robot going forward. To put the robot in reverse, you just need to change `FORWARD` to `BACKWARD`. Turning is just as easy. To turn right, you just need to turn off the right motor, and go `FORWARD` with the left motor. This brings us to the next bit of motor controller code you need to know, `RELEASE`. Instead of `FORWARD`, or `BACKWARD`, you can also use `RELEASE`. `RELEASE` is like pulling the plug on the motor. It will ignore speeds, and direction, and just stop what it is doing. The code for `RELEASE` looks like this:

```
leftMotor-&gt;run(RELEASE);
rightMotor-&gt;run(RELEASE);
```

If we take that to our sketch, we can now make the robot turn in circles by releasing the right motor, and going forward with the left motor:

```
/*
This is a test sketch for the Adafruit assembled Motor Shield for Arduino v2
It won't work with v1.x motor shields! Only for the v2's with built in PWM
control

For use with the Adafruit Motor Shield v2
----&gt;http://www.adafruit.com/products/1438
*/

#include &lt;Wire.h&gt;
#include &lt;Adafruit_MotorShield.h&gt;
#include "utility/Adafruit_MS_PWMServoDriver.h"
```

```
// Create the motor shield object with the default I2C address
Adafruit_MotorShield AFMS = Adafruit_MotorShield();
// Or, create it with a different I2C address (say for stacking)
// Adafruit_MotorShield AFMS = Adafruit_MotorShield(0x61);

// Set up the left motor on port M4
Adafruit_DCMotor *leftMotor = AFMS.getMotor(4);
// Set up the right motor on port M3
Adafruit_DCMotor *rightMotor = AFMS.getMotor(3);

void setup() {
  Serial.begin(9600);           // set up Serial library at 9600 bps
  Serial.println("Adafruit Motorshield v2 - Robot Test!");

  AFMS.begin();  // create with the default frequency 1.6KHz
  //AFMS.begin(1000);  // OR with a different frequency, say 1KHz
}

void loop() {
  // Set the speed to start, from 0 (off) to 255 (max speed)
  leftMotor-&gt;setSpeed(100);
  rightMotor-&gt;setSpeed(100);

  leftMotor-&gt;run(FORWARD); //LEFT MOTOR FULL STEAM AHEAD!
  rightMotor-&gt;run(RELEASE); //RIGHT MOTOR FULL STOP!
}
```

That just about covers the basics, now let's take this to the next level...

Code for Your Race Car

To take this robot to the next level, we are going to modify James De Vito's awesome code for the similar Red Robot Rover (). In his code, he has multiple control methods where you can either use the Bluefruit App controller or use your phone's accelerometer to drive your robot. For this example, I am going to simplify things and we will just use the control pad. This will free up the four auxiliary buttons for some customization which we will cover in a couple steps.

Libraries

For this code to work, we will need a couple libraries. See the previous step on a really easy way to install these libraries using the Arduino Library manager.

First up is the Adafruit BLE library. Learn more about this library and download it here. ()

Next, we will need the Adafruit MotorShield library. Learn more about this library and download it here. ()

The Code

Once you have the libraries installed, you will need to download the updated code. Click the button below to download. Then, double-click the archive to unzip it, and then move the MiniRaceCar folder to your Arduino sketches directory.

MiniRaceCar.zip

If you take a good look through this code, you will see it isn't so much more complicated than what we learned in the previous step. There is some complicated code that deals with the Bluetooth connection to your mobile device (which we will use in the next step). This version of the sketch also includes code for reading and streaming the temperature and humidity sensor data, which we'll look at a bit more later.

One neat feature we added is a way to slowly speed up the motors to full speed so it doesn't pop a wheelie when you take off going forward with this bit of code:

```
// speed up the motors
      for (int speed=0; speed &lt; maxspeed; speed+=5) {
        L_MOTOR-&gt;setSpeed(speed);
        R_MOTOR-&gt;setSpeed(speed);
        delay(5); // 250ms total to speed up
      }
```

We just use a simple for loop to slowly ramp up the speed until it hits max speed. Lear n more about for loops here ().

Driving Your Race Car

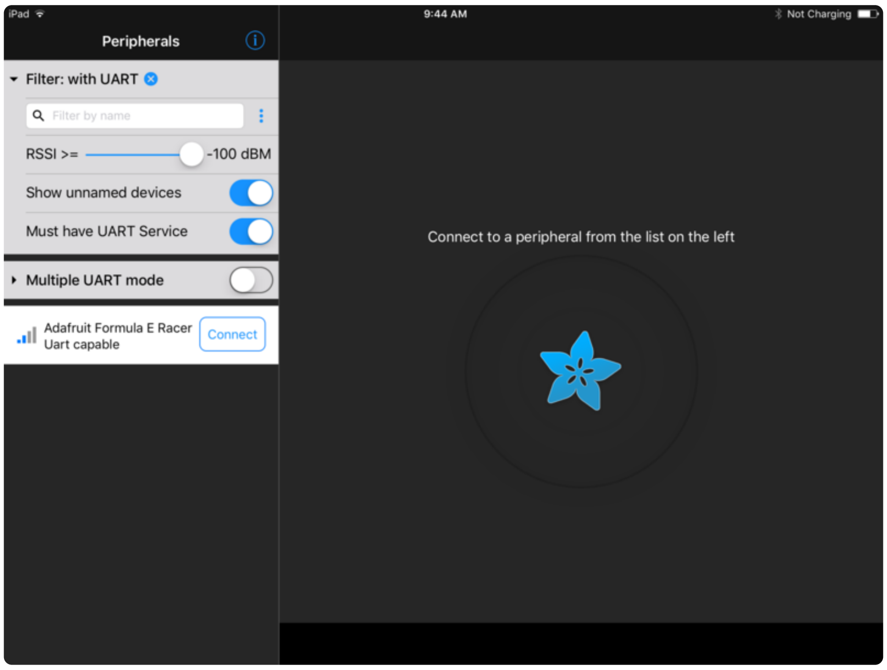
Now it is time to take control of your robot. We will be using the Adafruit Bluefruit LE Connect app. Go ahead and download it on your preferred device.

Bluefruit app for iOS

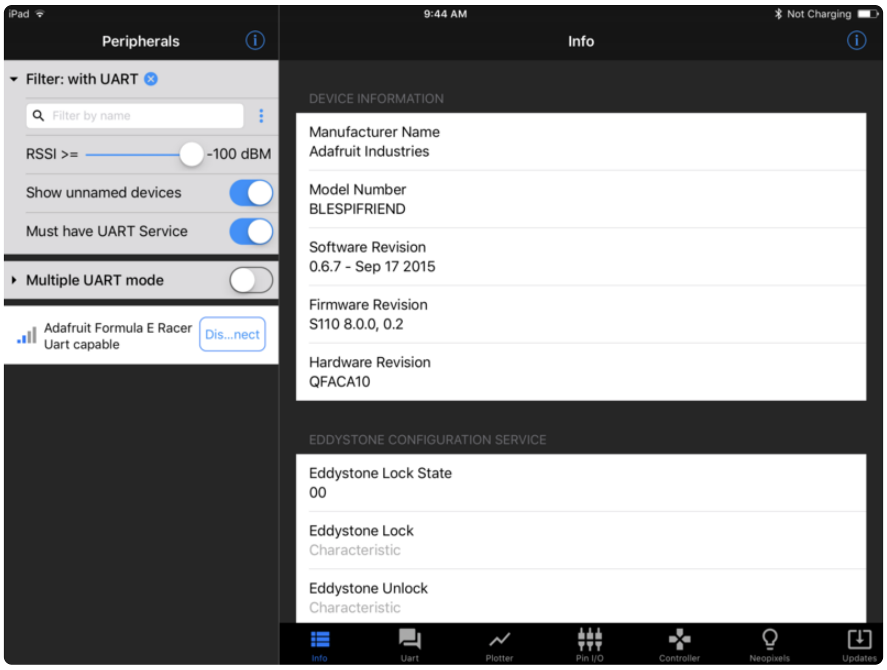
Bluefruit app for Android

Load up the Bluefruit LE Connect app, and the first thing you will see is a list of available Bluetooth devices to connect to. Find the one that says Adafruit Formula E Racer, and tap the Connect button.

Here's what it looks like on the iPad version:



Once you connect, you will see a whole bunch of device information. At the bottom of the app, tap the Controller button.



DEVICE INFORMATION

Manufacturer Name
Adafruit Industries

Model Number
BLESPIFRIEND

Software Revision
0.6.7 - Sep 17 2015

Firmware Revision
S110 8.0.0, 0.2

Hardware Revision
QFACA10

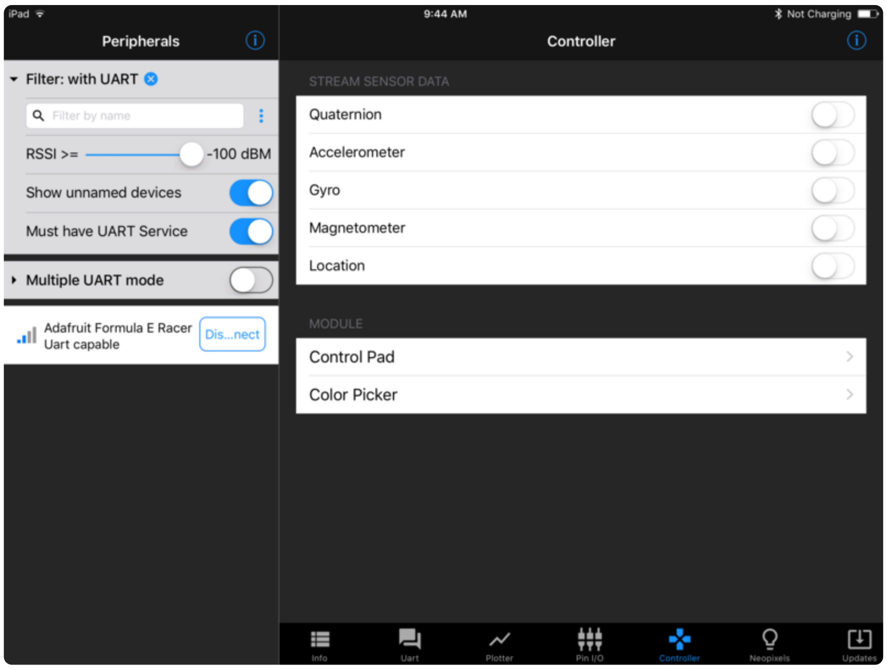
EDDYSTONE CONFIGURATION SERVICE

Eddystone Lock State
00

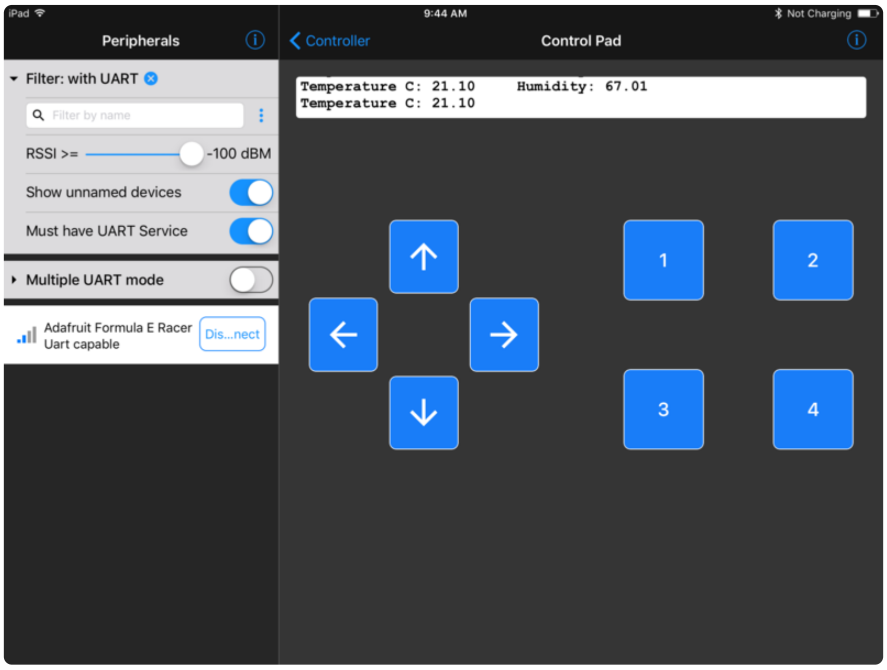
Eddystone Lock
Characteristic

Eddystone Unlock
Characteristic

On the next screen, you will see some advanced features of the app. For now, click the Control Pad link.



The Control Pad should load up, presenting four arrow keys, four assignable buttons, and a small readout for streaming data.

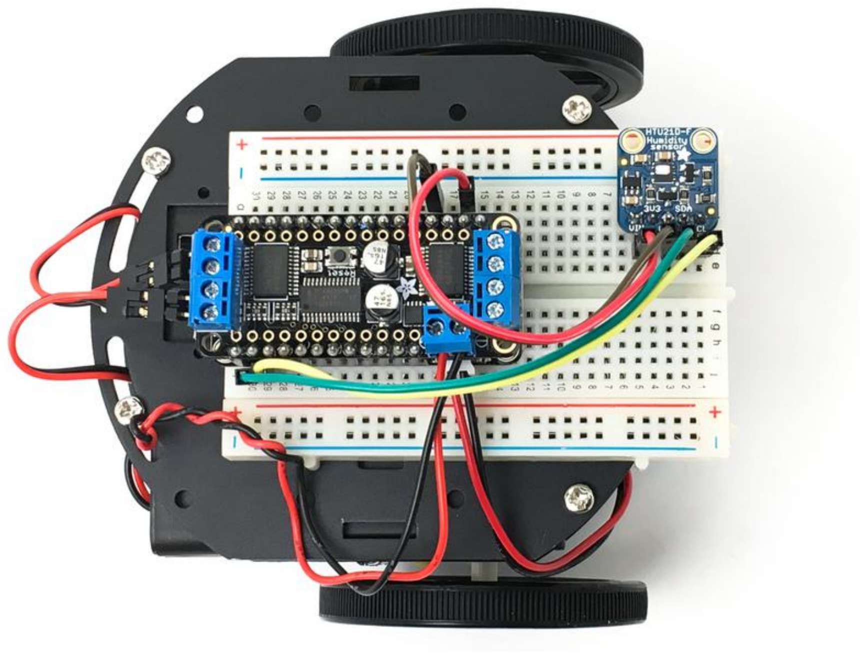


```
Temperature C: 21.10     Humidity: 67.01
Temperature C: 21.10
```

Make sure your race car is unplugged from USB (the LiPoly battery will provide power), and that the AA battery pack is turned on.

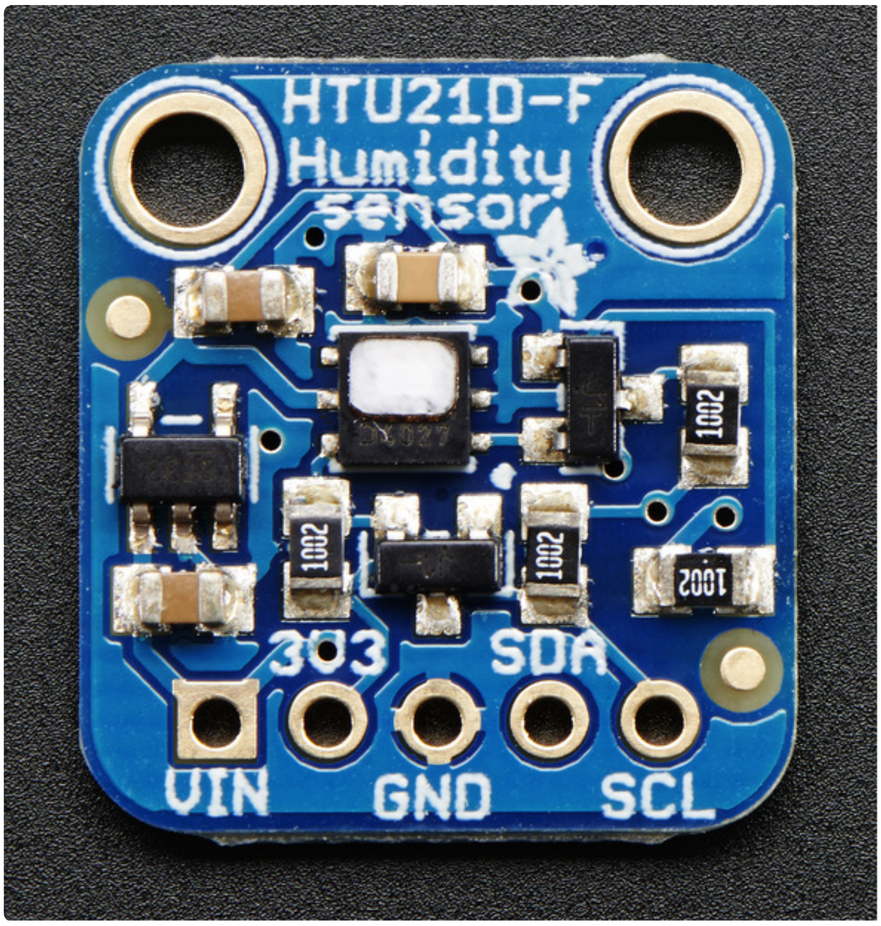
Then, go ahead and use the arrows to drive your rover. Be careful, this little guy is fast! Be sure to place it on the floor first!

Temperature and Humidity Data



In real-life race cars, monitoring the gearbox temperature is important for squeezing out the most performance from the car as is possible. As temperatures rise, oil viscosity becomes thinner, which is great for a time trial, but can be a problem in a longer race.

Included in your race car kit is the accurate and excellent HTU21D-F Temperature & Humidity Breakout Board, based on the TE Connectivity sensor. With it, you can measure the temperature and humidity of your race car, wirelessly! You can stream this data from the Bluefruit application on your mobile device, even while driving the car!!



First, you'll connect the sensor to your Feather, and read the data over the serial port.

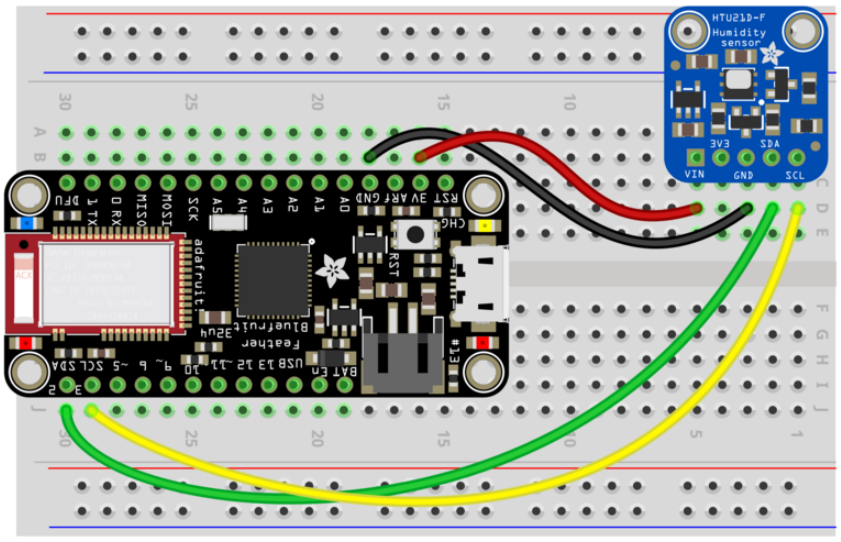
The HTU21D-F is an I2C sensor. That means it uses the two I2C data/clock wires available on most microcontrollers, and can share those pins with other sensors as long as they don't have an address collision.

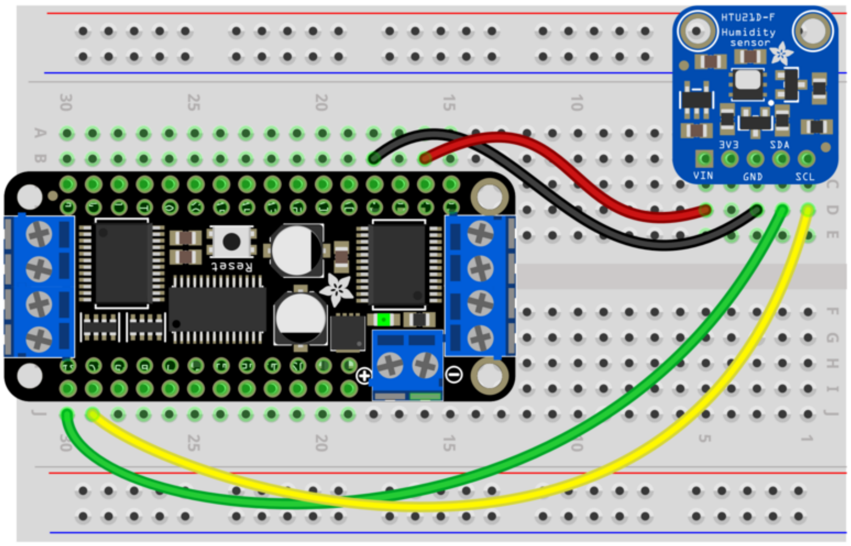
Power Pins:

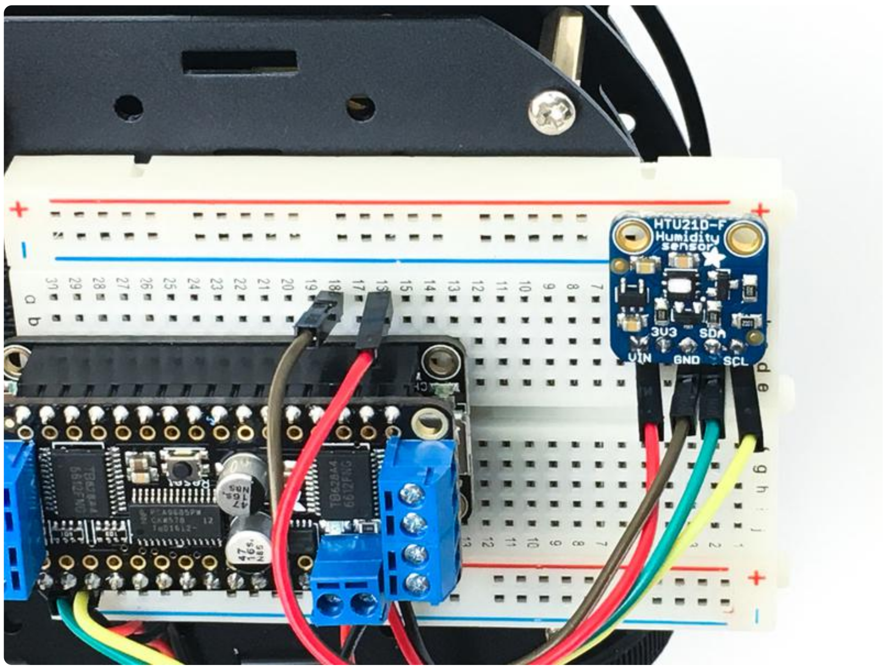
- Vin - this is the power pin. To power the board, plug it into the 3V pin on your Feather
- GND - common ground for power and logic, plug this into the GND pin on your Feather

I2C Logic pins:

- SCL - I2C clock pin, connect to your Feather's I2C clock line, labeled SCL
- SDA - I2C data pin, connect to your Feather's I2C data line, labeled SDA


HTU21D-F
Humidity sensor
VIN
GND
SCL
SDA
3V3
Bluefruit Feather
adafruit
32u4


HTU21D-F
Humidity sensor
VIN
GND
SCL
SDA
3V3
Reset


HTU21D-F
Humidity sensor
3V3
SDA
VIN
GND
SCL

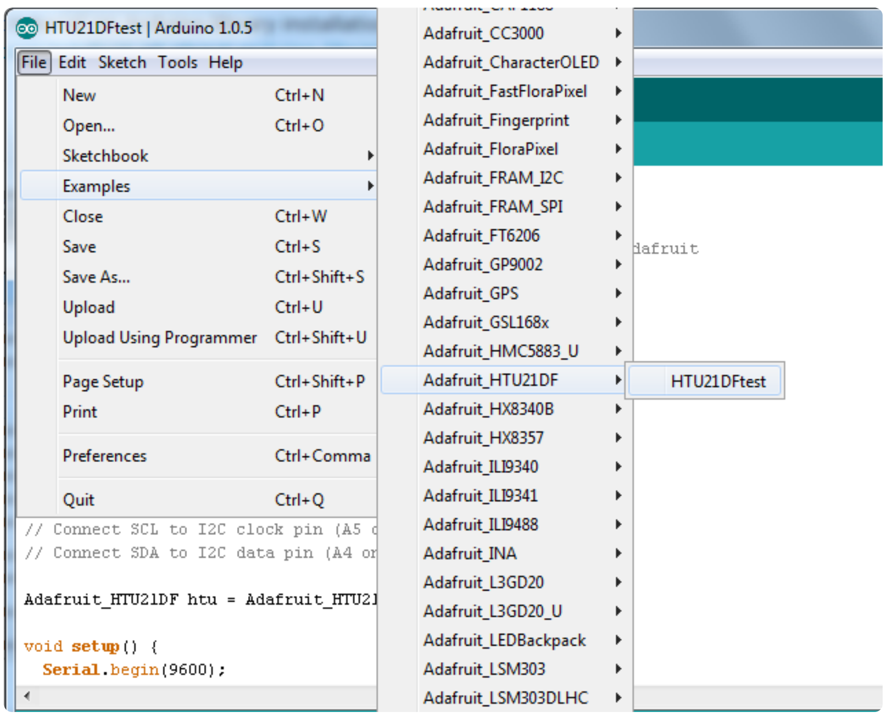
The HTU21D-F has a default I2C address of 0x40 and cannot be changed!

Download Adafruit_HTU21DF

To begin reading sensor data, you will need to download Adafruit_HTU21DF_Library from our github repository (). You can do that by visiting the github repo and manually downloading or, easier, download it from within the Arduino IDE. To do so, click on Sk etch > Include library > Manage libraries... and then within the pop-up window, search for "adafruit htu21df" then, select the library and click Install.

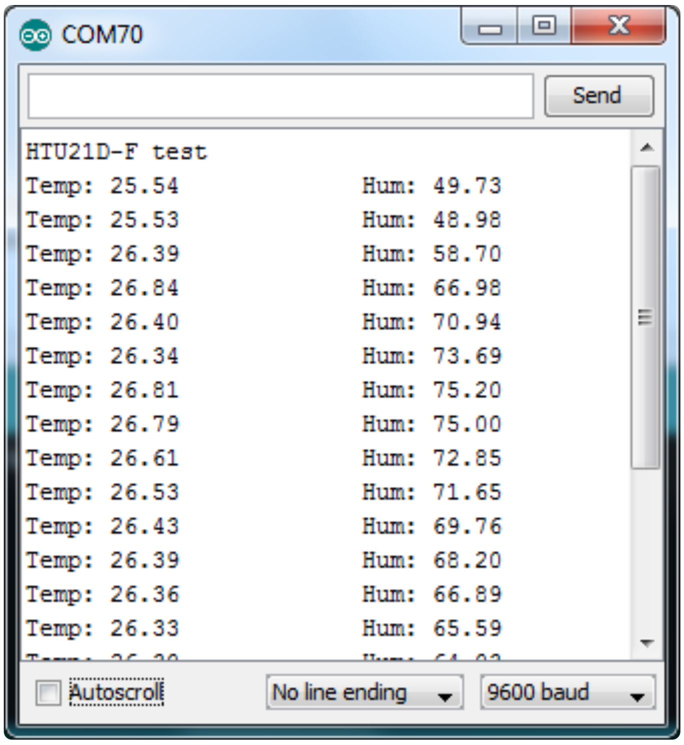
Load Demo

Open up File->Examples->Adafruit_HTU21DF->HTU21DFtest and upload to your Feather wired up to the sensor.



```
// Connect SCL to I2C clock pin (A5 o
// Connect SDA to I2C data pin (A4 or

Adafruit_HTU21DF htu = Adafruit_HTU21

void setup() {
  Serial.begin(9600);
```

Thats it! Now open up the serial monitor window to begin the test.



```
HTU21D-F test
Temp: 25.54          Hum: 49.73
Temp: 25.53          Hum: 48.98
Temp: 26.39          Hum: 58.70
Temp: 26.84          Hum: 66.98
Temp: 26.40          Hum: 70.94
Temp: 26.34          Hum: 73.69
Temp: 26.81          Hum: 75.20
Temp: 26.79          Hum: 75.00
Temp: 26.61          Hum: 72.85
Temp: 26.53          Hum: 71.65
Temp: 26.43          Hum: 69.76
Temp: 26.39          Hum: 68.20
Temp: 26.36          Hum: 66.89
Temp: 26.33          Hum: 65.59
```

You can try breathing on the sensor to increase the humidity. The sensor reacts very fast!

For more details on the sensor, check out the Learning Guide ()!

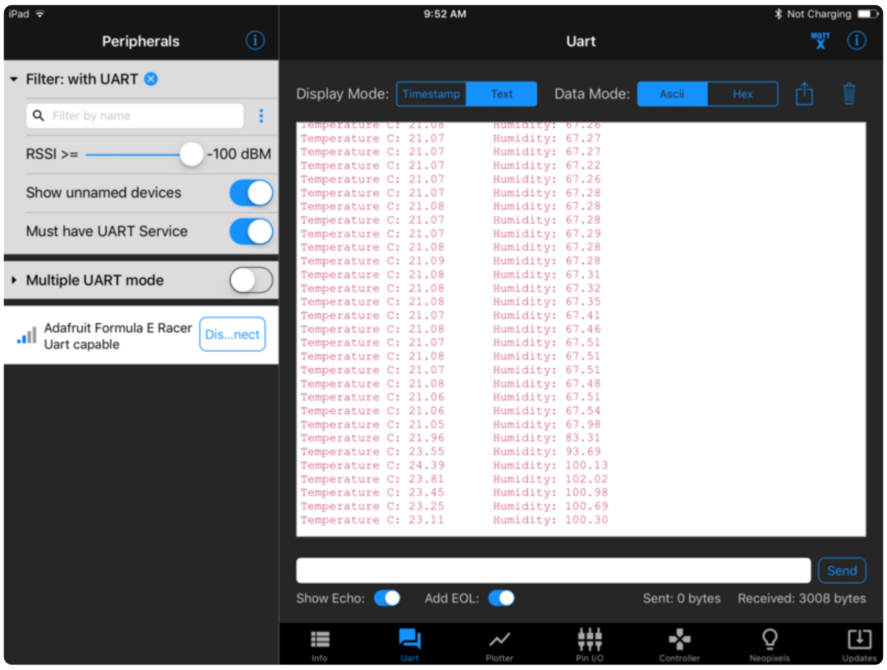
Bluetooth Data Streaming

The Bluefruit library makes it fairly simple to stream data as if it's going to the Serial monitor, but is instead traveling through the air to your phone or tablet!

By using the Adafruit BluefruitLE SPI command `ble.print(htu.readTemperature())` instead of `Serial.print(htu.readTemperature())` we can watch the device running the Bluefruit app instead of the computer's serial monitor to see the same data stream. Magic!

Re-upload the MiniRaceCar.ino sketch to your Feather, then, connect it to the Bluefruit app and click on the Uart button at the bottom.

Here's what it looks like when running:

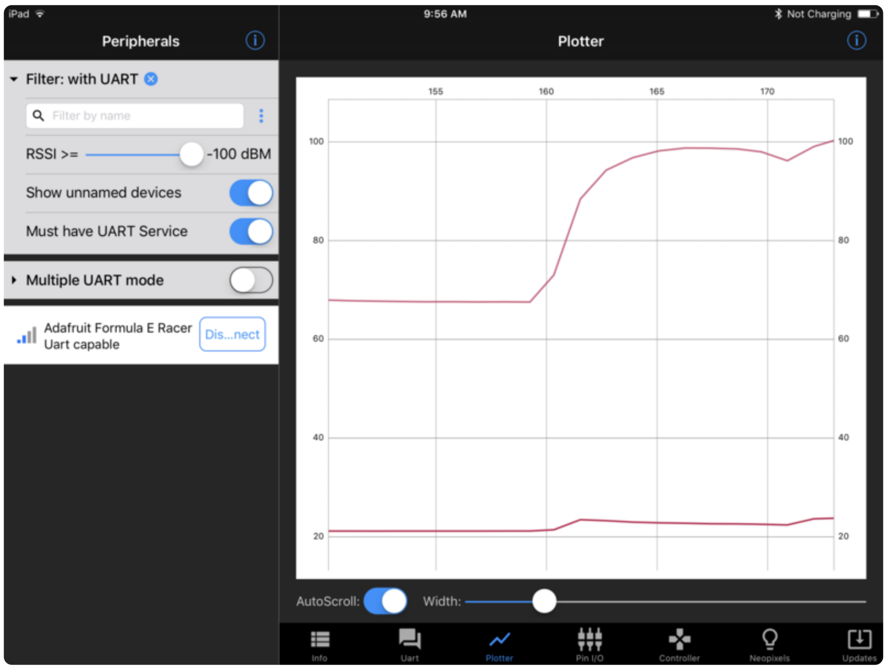


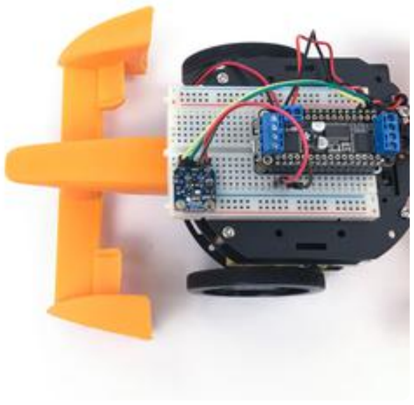
```
Temperature C: 21.08        Humidity: 67.26
Temperature C: 21.07        Humidity: 67.27
Temperature C: 21.07        Humidity: 67.27
Temperature C: 21.07        Humidity: 67.22
Temperature C: 21.07        Humidity: 67.26
Temperature C: 21.07        Humidity: 67.28
Temperature C: 21.08        Humidity: 67.28
Temperature C: 21.07        Humidity: 67.28
Temperature C: 21.07        Humidity: 67.29
Temperature C: 21.08        Humidity: 67.28
Temperature C: 21.09        Humidity: 67.28
Temperature C: 21.08        Humidity: 67.31
Temperature C: 21.08        Humidity: 67.32
Temperature C: 21.08        Humidity: 67.35
Temperature C: 21.07        Humidity: 67.41
Temperature C: 21.08        Humidity: 67.46
Temperature C: 21.07        Humidity: 67.51
Temperature C: 21.08        Humidity: 67.51
Temperature C: 21.07        Humidity: 67.51
Temperature C: 21.08        Humidity: 67.48
Temperature C: 21.06        Humidity: 67.51
Temperature C: 21.06        Humidity: 67.54
Temperature C: 21.05        Humidity: 67.98
Temperature C: 21.96        Humidity: 83.31
Temperature C: 23.55        Humidity: 93.69
Temperature C: 24.39        Humidity: 100.13
Temperature C: 23.81        Humidity: 102.02
Temperature C: 23.45        Humidity: 100.98
Temperature C: 23.25        Humidity: 100.69
Temperature C: 23.11        Humidity: 100.30
```

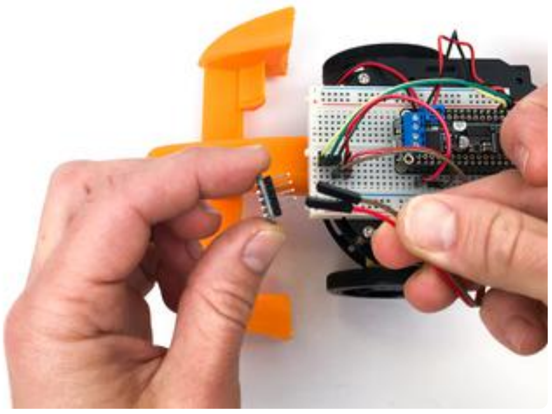
Plotting

Another great way to asses the changes in temperature and humidity of your race car over time is by visualizing it on a graph.

The Bluefruit app has a built in data plotter, here's what the data looks like when you breathe directly on the sensor:

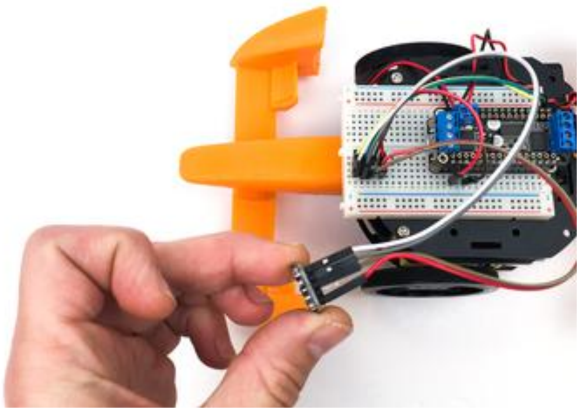


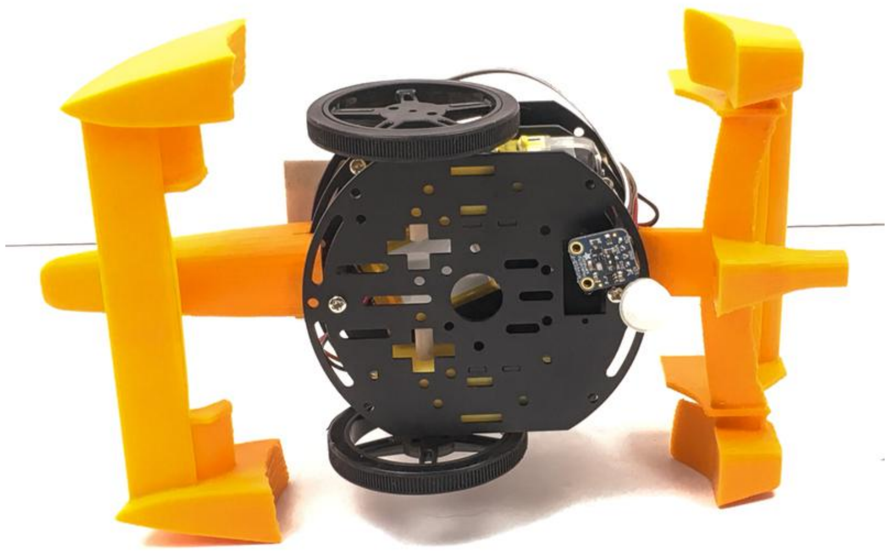


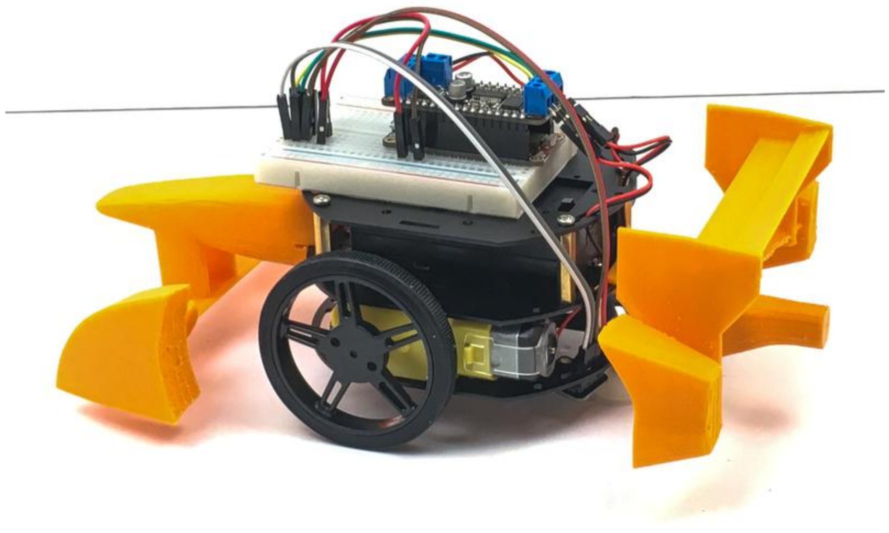


Sensor Placement

If you like, you can use the included Male/Female 6" jumper wires to extend the sensor and place it elsewhere on the car. Perhaps you want a better idea of the track temperature: place the sensor on the underside of the vehicle!







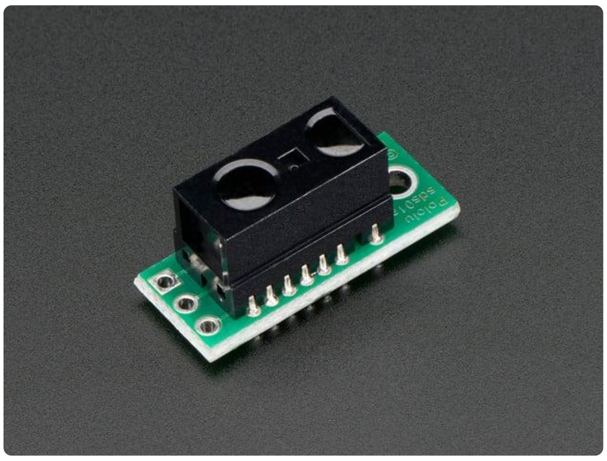
Make Your Race Car Autonomous

While it is definitely neat to use your phone to control your racer, it is time to set your little car free. The first step in making your racer autonomous is to add proximity sensors so it can avoid obstacles.

The simplest way to do this is to add a couple robot whiskers to sense when it physically runs into a wall or object. You simply write some code to listen for when the switch has been triggered, stop, turn around, and go forward again. These Micro Switches with a wire are perfect for this.

Micro Switch w/Wire - Three Terminals
Micro-switches are often found in arcade buttons and joysticks but they're also really handy in any kind of mechatronics project or when you need a basic sensor. They are always...
https://www.adafruit.com/product/820

While this is a great way to navigate around obsticles, I prefer to use a something a bit more intelligent so my little robot doesn't actually have to run into things to navigate. There are plenty of distance sensor options out there (there is a whole category of them () on the Adafruit shop), but the sensor I am going to use is the neat little IR sensor from from Sharp.



Sharp GP2Y0D810Z0F Digital Distance Sensor with Pololu Carrier
If you're like me, you've always wanted a smaller and faster way to sense an object between 2 and 10 centimeters away. If you're really like me, you've wanted the...
https://www.adafruit.com/product/1927

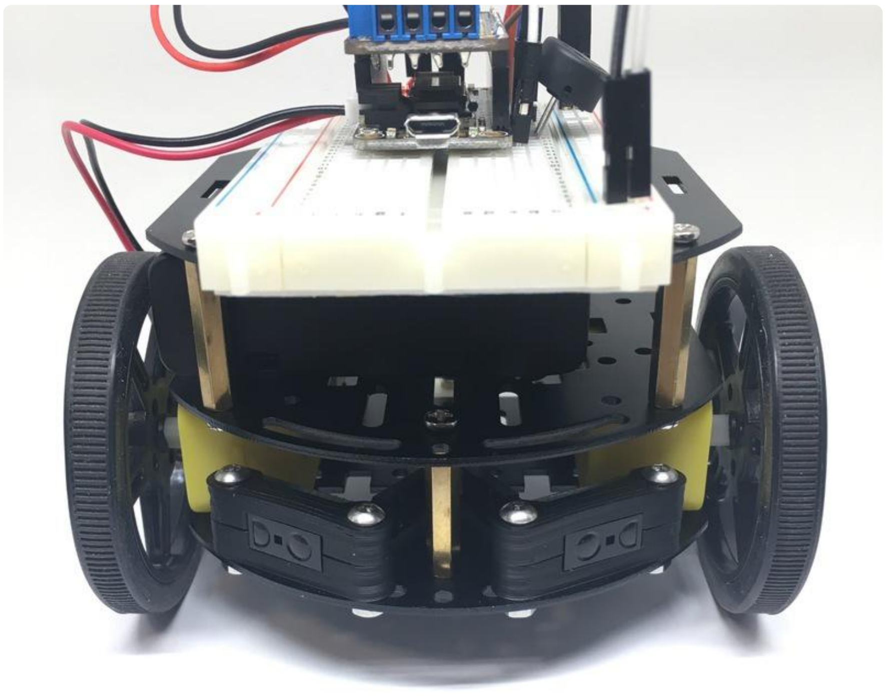
The obvious benefit here is the size, but also the price. This little sensor will sense an object about 10 centimeters away, and acts like a normal switch. There is a pin on the board that is normally high and switches to low when it senses an object. Because of the small size, we can put two of these on our little robot.

Mounting the Sensors

There are a ton of ways you can mount this sensor to your robot. The easiest way would be to just a bit of double sided foam tape to stick it in place, but I decided to make a super simple 3D printed mount.

Note, this will not work with the Formula E race car nose part mounted

Click Here to Download the Mount



I used a couple M2.5 screws to secure the mounts to the robot (required a drill bit to clean up the holes in the 3D print). I wired up the left sensor to pin A4, and the right sensor to pin A5.

The Code

The code to make your robot take advantage of its new eyes is very straight forward. For now, we are going to focus on the Adafruit MotorShield library.

Learn More About the Adafruit MotorShield Library

```
#include &lt;Wire.h&gt;
#include &lt;Adafruit_MotorShield.h&gt;
#include "utility/Adafruit_MS_PWMServoDriver.h"

// Create the motor shield object with the default I2C address
Adafruit_MotorShield AFMS = Adafruit_MotorShield();

// And connect 2 DC motors to port M3 &amp; M4 !
Adafruit_DCMotor *L_MOTOR = AFMS.getMotor(3);
Adafruit_DCMotor *R_MOTOR = AFMS.getMotor(4);
```

```
// And connect the Sharp distance sensors
int leftSensor = A4;
int rightSensor = A5;

void setup() {
  Serial.begin(9600);           // set up Serial library at 9600 bps
  Serial.println("Adafruit Motorshield v2 - DC Motor test!");

  pinMode(leftSensor, INPUT); // set up distance sensor pins
  pinMode(rightSensor, INPUT);

  AFMS.begin();  // create with the default frequency 1.6KHz

}

void loop() {
  L_MOTOR-&gt;setSpeed(200);
  R_MOTOR-&gt;setSpeed(200);
  L_MOTOR-&gt;run(FORWARD);
  R_MOTOR-&gt;run(FORWARD);

  while (digitalRead(rightSensor) == LOW){
    L_MOTOR-&gt;setSpeed(100);
    R_MOTOR-&gt;setSpeed(100);
    L_MOTOR-&gt;run(BACKWARD);
    R_MOTOR-&gt;run(RELEASE);
  }

  while (digitalRead(leftSensor) == LOW){
    L_MOTOR-&gt;setSpeed(100);
    R_MOTOR-&gt;setSpeed(100);
    L_MOTOR-&gt;run(RELEASE);
    R_MOTOR-&gt;run(BACKWARD);
  }
}
```

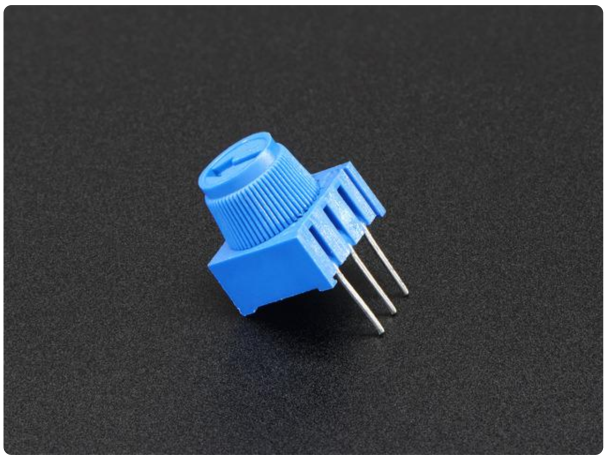
As you can see from the above code, there isn't a whole lot going on here. All we are doing is reading one of the distance sensors, and if it senses an object we reverse the opposite side motor until the object is no longer detected. We also slow things down quite a bit, as this little robot is so quick it loves to pop wheelies when it starts and stops quickly.

This is just the beginning of what you can do with distance sensing. The next steps are up to you. You can integrate this code into the bluetooth controller code to turn on and off auto mode with a button press. What other ideas can you think of?

Control Your Race Car's Speed

Instead of hard coding a specific speed for your race car, here we will use a couple different ways to adjust your speed without having to constantly upload new code.

The first way we are going to adjust the speed is with a simple breadboard trim potentiometer. Pick one up on the Adafruit Shop:



Breadboard trim potentiometer
These are our favorite trim pots, perfect for breadboarding and prototyping. They have a long grippy adjustment knob and with 0.1" spacing, they plug into breadboards or...
https://www.adafruit.com/product/356

Potentiometers, or Pots for short, are variable resistors that allow us to send different voltages to the Feather analog pin. Wiring it up is super simple. Just connect one of the outside pins to a 3.3V pin, and the other outside pin to ground. Then, connect the middle pin to the A0 pin on the Feather. For a reminder on which pin is which on the Bluefruit Feather, click here ().

The code to get this all working is incredibly simple. Just copy and paste in the code below to the top of your main loop.

```
//Set your motor speed
int reading  = analogRead(A0);
L_MOTOR-&gt;setSpeed(map(reading, 0, 1023, 0, 255));
R_MOTOR-&gt;setSpeed(map(reading, 0, 1023, 0, 255));
```

So, it should look something like this now:

```
void loop(void)
{

  //Set your motor speed
  int reading  = analogRead(A0);
  L_MOTOR-&gt;setSpeed(map(reading, 0, 1023, 0, 255));
  R_MOTOR-&gt;setSpeed(map(reading, 0, 1023, 0, 255));


  // read new packet data
  uint8_t len = readPacket(&amp;ble, BLE_READPACKET_TIMEOUT);

  readController();

}
```

What we are doing here is reading that analog pin, and the Feather is going to pull a number from 0 to 1023, depending on which direction the arrow is facing on your pot. Because the motor controller needs a value from 0 to 255, we are using the map() function ().

Go ahead and upload this code to your race car, and turn the pot, then press forward on the controller to see how it works. Keep changing to direction of the arrow on the pot to adjust the speed.

Using the Controller to Control Speed

If you would rather just control your car's speed using the extra 4 buttons on the controller, it is also pretty easy to set up. First off, we need to set up a global speed variable. Anywhere above the sketch setup, add in something like this:

```
int robotSpeed = 100;
```

In the main loop, we can then use that variable to set the motor speed using:

```
L_MOTOR-&gt;setSpeed(robotSpeed);
R_MOTOR-&gt;setSpeed(robotSpeed);
```

Then, all we need to do is increment the speed up every time we press the 1 button, and down every time we press the 3 button.

```
if(buttnum == 1){
    if(robotSpeed &lt;= 245){
        robotSpeed = robotSpeed + 10;
    }
}

if(buttnum == 2){
}

if(buttnum == 3){
    if(robotSpeed &gt;=10){
        robotSpeed = robotSpeed - 10;
    }
}
```

```
if(buttnum == 4){
}
```

Here is the whole block of code for you to copy and paste in:

```
/*********************************************************************
 This is an example for our nRF51822 based Bluefruit LE modules

 Modified to drive a 3-wheeled BLE Robot Rover! by http://james.devi.to

 Pick one up today in the Adafruit shop!

 Adafruit invests time and resources providing this open source code,
 please support Adafruit and open-source hardware by purchasing
 products from Adafruit!

 MIT license, check LICENSE for more information
 All text above, and the splash screen below must be included in
 any redistribution
*********************************************************************/

#include &lt;string.h&gt;
#include &lt;Arduino.h&gt;
#include &lt;SPI.h&gt;
#if not defined (_VARIANT_ARDUINO_DUE_X_)
  #include &lt;SoftwareSerial.h&gt;
#endif

#include "Adafruit_BLE.h"
#include "Adafruit_BluefruitLE_SPI.h"
#include "Adafruit_BluefruitLE_UART.h"

#include "BluefruitConfig.h"

#include &lt;Wire.h&gt;
#include &lt;Adafruit_MotorShield.h&gt;

// Create the motor shield object with the default I2C address
Adafruit_MotorShield AFMS = Adafruit_MotorShield();

// And connect 2 DC motors to port M3 &amp; M4 !
Adafruit_DCMotor *L_MOTOR = AFMS.getMotor(3);
Adafruit_DCMotor *R_MOTOR = AFMS.getMotor(4);

//Name your RC here
String BROADCAST_NAME = "Adafruit Black Robot Rover";

String BROADCAST_CMD = String("AT+GAPDEVNAME=" + BROADCAST_NAME);

Adafruit_BluefruitLE_SPI ble(BLUEFRUIT_SPI_CS, BLUEFRUIT_SPI_IRQ,
BLUEFRUIT_SPI_RST);

// A small helper
void error(const __FlashStringHelper*err) {
  Serial.println(err);
  while (1);
}

// function prototypes over in packetparser.cpp
uint8_t readPacket(Adafruit_BLE *ble, uint16_t timeout);
float parsefloat(uint8_t *buffer);
void printHex(const uint8_t * data, const uint32_t numBytes);

// the packet buffer
extern uint8_t packetbuffer[];
```

```
char buf[60];

int robotSpeed = 100;

/**************************************************************************/
/*!
    @brief  Sets up the HW an the BLE module (this function is called
            automatically on startup)
*/
/**************************************************************************/
void setup(void)
{
  Serial.begin(9600);

  AFMS.begin();  // create with the default frequency 1.6KHz

  // turn on motors
  L_MOTOR-&gt;setSpeed(0);
  L_MOTOR-&gt;run(RELEASE);

  R_MOTOR-&gt;setSpeed(0);
  R_MOTOR-&gt;run(RELEASE);

  Serial.begin(115200);
  Serial.println(F("Adafruit Bluefruit Robot Controller Example"));
  Serial.println(F("-----------------------------------------"));

  /* Initialize the module */
  BLEsetup();

  //Set your motor speed (255 Max)
  L_MOTOR-&gt;setSpeed(robotSpeed);
  R_MOTOR-&gt;setSpeed(robotSpeed);
}

void loop(void)
{
  L_MOTOR-&gt;setSpeed(robotSpeed);
  R_MOTOR-&gt;setSpeed(robotSpeed);

  // read new packet data
  uint8_t len = readPacket(&amp;ble, BLE_READPACKET_TIMEOUT);

  readController();

}


bool readController(){

 // Buttons
  if (packetbuffer[1] == 'B') {

    uint8_t buttnum = packetbuffer[2] - '0';
    boolean pressed = packetbuffer[3] - '0';

    if (pressed) {
      if(buttnum == 1){
        if(robotSpeed &lt;= 245){
          robotSpeed = robotSpeed + 10;
        }

      }

      if(buttnum == 2){

      }
      if(buttnum == 3){
        if(robotSpeed &gt;=10){
          robotSpeed = robotSpeed - 10;
        }
      }

      if(buttnum == 4){

      }

      if(buttnum == 5){
        L_MOTOR-&gt;run(FORWARD);
        R_MOTOR-&gt;run(FORWARD);
      }

      if(buttnum == 6){
        L_MOTOR-&gt;run(BACKWARD);
        R_MOTOR-&gt;run(BACKWARD);
      }

      if(buttnum == 7){
        L_MOTOR-&gt;run(RELEASE);
        R_MOTOR-&gt;run(FORWARD);
      }

      if(buttnum == 8){
        L_MOTOR-&gt;run(FORWARD);
        R_MOTOR-&gt;run(RELEASE);
      }
  }
  else {
      L_MOTOR-&gt;run(RELEASE);
      R_MOTOR-&gt;run(RELEASE);
    }
}
}

void BLEsetup(){
  Serial.print(F("Initialising the Bluefruit LE module: "));

  if ( !ble.begin(VERBOSE_MODE) )
  {
    error(F("Couldn't find Bluefruit, make sure it's in CoMmanD mode &amp; check 
wiring?"));
  }
  Serial.println( F("OK!") );

  /* Perform a factory reset to make sure everything is in a known state */
  Serial.println(F("Performing a factory reset: "));
  if (! ble.factoryReset() ){
       error(F("Couldn't factory reset"));
  }

  //Convert the name change command to a char array
  BROADCAST_CMD.toCharArray(buf, 60);

  //Change the broadcast device name here!
  if(ble.sendCommandCheckOK(buf)){
    Serial.println("name changed");
  }
  delay(250);

  //reset to take effect
  if(ble.sendCommandCheckOK("ATZ")){
    Serial.println("resetting");
  }
  delay(250);

  //Confirm name change
  ble.sendCommandCheckOK("AT+GAPDEVNAME");

  /* Disable command echo from Bluefruit */
  ble.echo(false);

  Serial.println("Requesting Bluefruit info:");
  /* Print Bluefruit information */
  ble.info();

  Serial.println(F("Please use Adafruit Bluefruit LE app to connect in Controller
mode"));
  Serial.println(F("Then activate/use the sensors, color picker, game controller,
etc!"));
  Serial.println();

  ble.verbose(false);  // debug info is a little annoying after this point!

  /* Wait for connection */
  while (! ble.isConnected()) {
      delay(500);
  }

  Serial.println(F("*****************"));

  // Set Bluefruit to DATA mode
  Serial.println( F("Switching to DATA mode!") );
  ble.setMode(BLUEFRUIT_MODE_DATA);

  Serial.println(F("*****************"));
}
```

Connecting Your Race Car to Adafruit IO

One of the great things about using the Adafruit Feather system is that you can easily swap out Feathers and FeatherWings to make your projects do different things. In this case we are going to use all of the upgrades from the previous steps, but we are going to swap out the 32u4 Bluefruit LE Feather for a HUZZAH ESP8266 Feather. This will allow us to connect our race car to Adafruit IO and log the temperature and humidity, as well as control the race car's speed from afar.

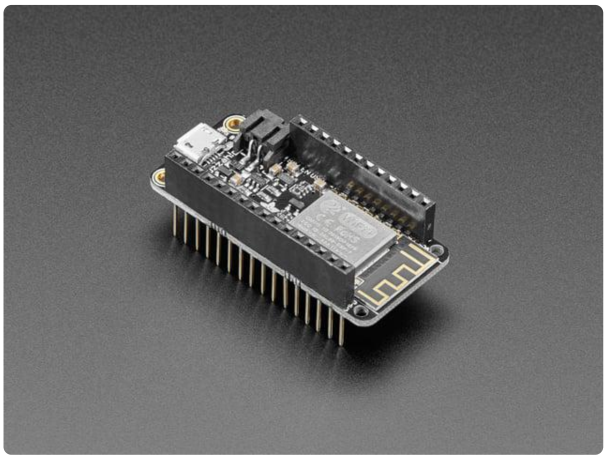
Sign up for Adafruit IO and create your first dashboard.

The first thing to do is head on over to io.adafruit.com () and sign up. Then click on dashboards in the left sidebar and under the actions dropdown, click create new dashboard. Name the dashboard whatever you want (like My Race Car), add a description if you want, and click the create button.

Send data to Adafruit IO

Before we start controlling the race car from Adafruit IO, lets just make sure everything is working by streaming some temperature and humidity data and monitoring it on a graph.

If you haven't already, you will need to swap out the Bluefruit Feather for a HUZZAH Feather. Don't have a HUZZAH Feather? Get one here:



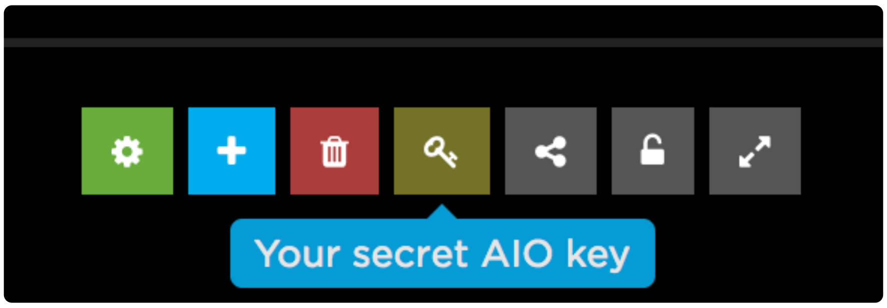
Assembled Feather HUZZAH w/ ESP8266 WiFi With Stacking Headers
Feather is the new development board from Adafruit, and like its namesake, it is thin, light, and lets you fly! We designed Feather to be a new standard for portable microcontroller...
https://www.adafruit.com/product/3213

Just gently lift off the motor FeatherWing with the wires still attached, and then gently remove the Bluefruit Feather from the breadboard (be sure to remember where the pins were located. Install the Feather HUZZAH in the exact same spot and attach the Motor FeatherWing.

Next, download the following file and open it in the Arduino IDE.

Temp & Humidity Test

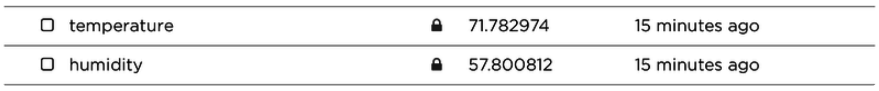
If this is your first time using Adafruit IO, on that config page, you will need to enter your secret key and username into the config tab. On your newly created dashboard, click on the yellow key icon in the upper right:



On the next page you will find your username and unique key. Copy and paste those into the corresponding spots on the Config tab. Then, enter your wifi SSID and password.

Go ahead and upload this to your HUZZAH. Open the Arduino serial terminal and make sure you connected to AIO, and that data is streaming.

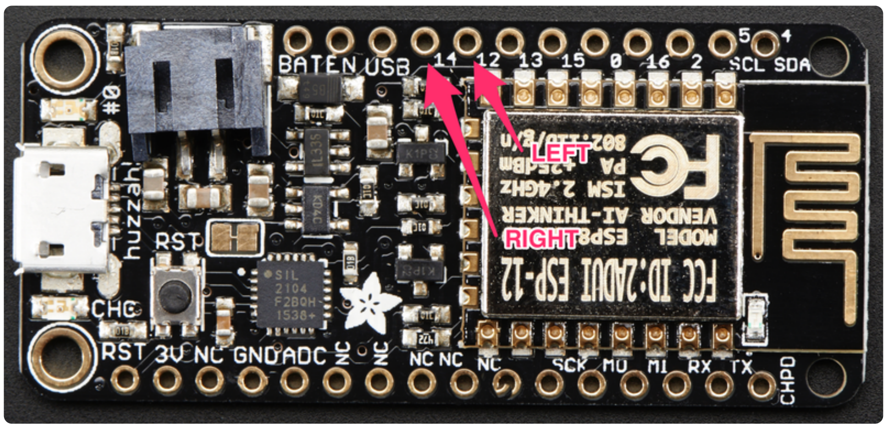
Now, lets add in a graph and view the data in real time. Click the blue '+' icon and then select the line graph option. On the next page, choose the temperature and humidity feeds that we just created:



☐	temperature	71.782974	15 minutes ago
☐	humidity	57.800812	15 minutes ago

On the next page, name your graph and click save. Feel free to click the green 'Edit this dashboard' button and drag around your graph, resize, and maybe change the graph from live to 1 hour. Click 'DONE EDITING' to save your changes. You should now see data slowly streaming on your graph. Now it's time to control your race car.

There are some minor pin changes between the HUZZAH and Bluefruit Feathers. Because of this, we need to move the pins for our autonomous sensors. Move the left sensor to HUZZAH pin 12, and the right sensor to pin 14:


LEFT
RIGHT
BAT EN USB 14 12 13 15 0 16 2 SCL SDA
RST 3V NC GND ADC NC NC NC NC NC SCK MO MI RX TX CHPD

Next, add a slider to your dashboard in the same way that you created the graph. This time instead of choosing a feed, we are going to create one. In the upper right, name your feed 'racecarspeed'

racecarspeed

Click create, and then name your slider 'Race Car Speed', leave the minimum value at 0, and set the max to 255. Save and add the slider to your dashboard.

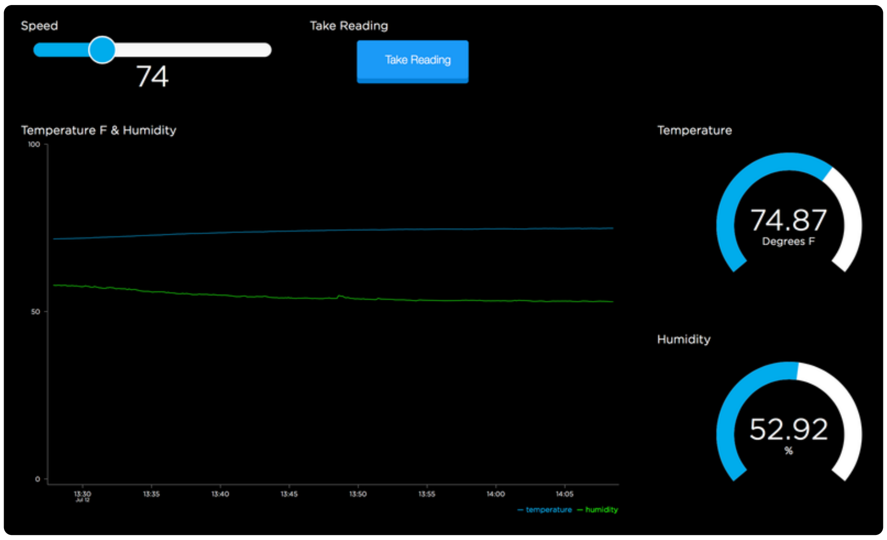
We also need to create a button. We are going to use the button to manually ask for the temperature and humidity instead of constantly streaming. Create a monetary button and name it 'racecartakereading'

Next, we will upload some modified code and give this all a test. Copy and paste in the below code over the Temperature and Humidity test code:

```
// Adafruit IO Temperature &amp; Humidity Example
// Tutorial Link: https://learn.adafruit.com/adafruit-io-basics-temperature-and-
humidity
//
// Adafruit invests time and resources providing this open source code.
// Please support Adafruit and open source hardware by purchasing
// products from Adafruit!
//
// Written by Todd Treece for Adafruit Industries
// Copyright (c) 2016-2017 Adafruit Industries
// Licensed under the MIT license.
//
// All text above must be included in any redistribution.

/************************** Configuration ***********************************/

// edit the config.h tab and enter your Adafruit IO credentials
// and any additional configuration needed for WiFi, cellular,
// or ethernet clients.
#include "config.h"

/************************ Example Starts Here *******************************/
#include &lt;Wire.h&gt;
#include "Adafruit_HTU21DF.h"
#include &lt;Adafruit_MotorShield.h&gt;

// Create the motor shield object with the default I2C address
Adafruit_MotorShield AFMS = Adafruit_MotorShield();

// And connect 2 DC motors to port M3 &amp; M4 !
Adafruit_DCMotor *L_MOTOR = AFMS.getMotor(3);
Adafruit_DCMotor *R_MOTOR = AFMS.getMotor(4);

// set up the 'temperature' and 'humidity' feeds
AdafruitIO_Feed *temperature = io.feed("temperature");
AdafruitIO_Feed *humidity = io.feed("humidity");
AdafruitIO_Feed *racecarspeed = io.feed("racecarspeed");
AdafruitIO_Feed *racecartakereading = io.feed("racecartakereading");

Adafruit_HTU21DF htu = Adafruit_HTU21DF();

int RaceCar_Speed = 10;

// And connect the Sharp distance sensors
int leftSensor = 12;
int rightSensor = 14;

void setup() {

  // start the serial connection
  Serial.begin(115200);
  AFMS.begin();  // create with the default frequency 1.6KHz

  // turn on motors
  L_MOTOR-&gt;setSpeed(0);
  L_MOTOR-&gt;run(RELEASE);

  R_MOTOR-&gt;setSpeed(0);
  R_MOTOR-&gt;run(RELEASE);

  pinMode(leftSensor, INPUT); // set up distance sensor pins
  pinMode(rightSensor, INPUT);

  // wait for serial monitor to open
  while(! Serial);

  Serial.println("HTU21D-F test");

  if (!htu.begin()) {
    Serial.println("Couldn't find sensor!");
    while (1);
  }

  // connect to io.adafruit.com
  Serial.print("Connecting to Adafruit IO");
  io.connect();

  // wait for a connection
  while(io.status() &lt; AIO_CONNECTED) {
    Serial.print(".");
    delay(500);
  }

  // we are connected
  Serial.println();
  Serial.println(io.statusText());

  racecarspeed-&gt;onMessage(handleSpeed);
  racecartakereading-&gt;onMessage(handleReading);

  //Set your motor speed (255 Max)
  L_MOTOR-&gt;setSpeed(RaceCar_Speed);
  R_MOTOR-&gt;setSpeed(RaceCar_Speed);

}

void loop() {

  // io.run(); is required for all sketches.
  // it should always be present at the top of your loop
  // function. it keeps the client connected to
  // io.adafruit.com, and processes any incoming data.
  io.run();

  L_MOTOR-&gt;setSpeed(RaceCar_Speed);
  R_MOTOR-&gt;setSpeed(RaceCar_Speed);
  L_MOTOR-&gt;run(FORWARD);
  R_MOTOR-&gt;run(FORWARD);

  if (digitalRead(rightSensor) == LOW){
    Serial.print("Right Sensor Triggered");
  }

  while (digitalRead(rightSensor) == LOW){
    L_MOTOR-&gt;setSpeed(RaceCar_Speed/2);
    R_MOTOR-&gt;setSpeed(RaceCar_Speed/2);
    L_MOTOR-&gt;run(BACKWARD);
    R_MOTOR-&gt;run(RELEASE);
  }
  while (digitalRead(leftSensor) == LOW){
    L_MOTOR-&gt;setSpeed(RaceCar_Speed/2);
    R_MOTOR-&gt;setSpeed(RaceCar_Speed/2);
    L_MOTOR-&gt;run(RELEASE);
    R_MOTOR-&gt;run(BACKWARD);
  }
}

void handleSpeed(AdafruitIO_Data *data) {

  // convert the data to integer
  RaceCar_Speed = data-&gt;toInt();

  Serial.print("speed: ");
  Serial.println(RaceCar_Speed);

}

void handleReading(AdafruitIO_Data *data) {

  float celsius = htu.readTemperature();
  float fahrenheit = (celsius * 1.8) + 32;

  Serial.print("celsius: ");
  Serial.print(celsius);
  Serial.println("C");

  Serial.print("fahrenheit: ");
  Serial.print(fahrenheit);
  Serial.println("F");

  // save fahrenheit (or celsius) to Adafruit IO
  temperature-&gt;save(fahrenheit);

  Serial.print("humidity: ");
  Serial.print(htu.readHumidity());
  Serial.println("%");

  // save humidity to Adafruit IO
  humidity-&gt;save(htu.readHumidity());
}
```

Upload the above code (make sure you have your config file the same as before). Prop your race car up off the ground and try sliding the speed slider. The wheel speed should go from off to full speed.

You should also be able to press the Take Reading button and see data show up on your graph. Feel free to add some other dashboard blocks like the gauge to show the current temperature and humidity. Organize your dashboard the way you want. Here is how I organized mine:



What else can you control with AIO on your race car? How about adding in a piezo buzzer and creating a horn? Maybe a button to put your race car in reverse? Tell us what you did to your race car in the Adafruit Forums ().