Introduction to JavaScript Electronics

Beginning Arduino development with JavaScript and Node.js

Mate Marschalko

Introduction to JavaScript Electronics
by **Mate Marschalko**

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Web on Devices

Electronics Hacking with JavaScript and other Web Technologies

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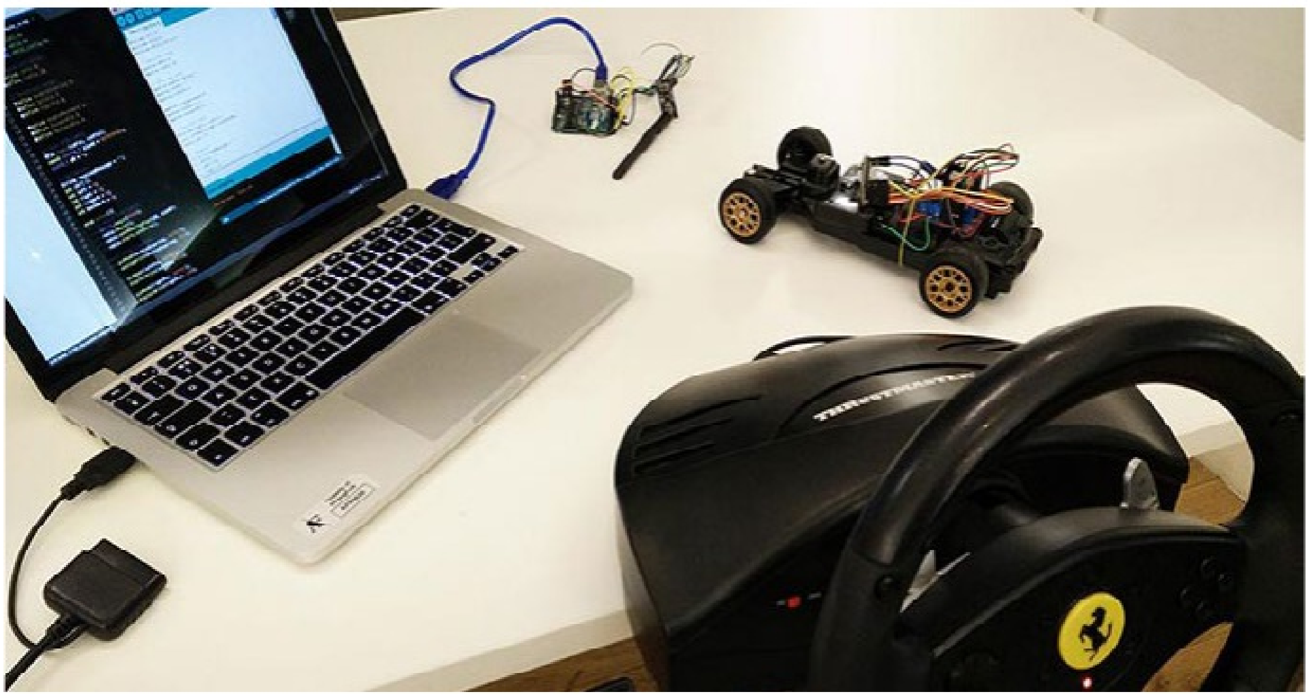
INTRODUCTION

In recent years, JavaScript has evolved past merely being a tool for DOM manipulation and begun to RkcNaQVgf Var hRaPRORl baQgUR eRNY_ f bSgUR Oebj f Re window. We now see JavaScript appearing on operating systems (Chrome OS, Firefox OS), on the server (Node. JS), and even on tiny microcontroller chips. It has also begun to become commonplace to see developers building hardware prototypes, or electronic toys, using JavaScript on prototyping platforms like the Arduino. These platforms and development boards made working with electronics possible for those without a background in electrical engineering.

The Internet of Things, a network of simple connected devices, are paving new ways to market and advertise products through physical experiences, Nf j RYYNf ORVa T NTeRNgqa NaPWNYVai Rfg_ Ra g Sbe developers to shift their skills towards building physical applications. Even today, forward thinking agencies

have started hiring Front-end Creative Technologists. IURfR QRiRYbcRef NeR abg baYl cebqPVRag Va OhVQVaT websites but are also able to build Interactive Kiosks, Virtual Reality experiences or other interactive hardware prototypes. They not only earn a lot more compared to regular front-end developers, but they get to play with all the latest gadgets and toys in their day-to-day job!



Playing with an Arduino RC car

IUVf fUbegObbX j VYYURYc lbh gNXR gUR qefg step into the world of Creative Technology, and start building electronic prototypes with the Arduino UNO development board and JavaScript. After the introduction, you will learn about the basics of electricity, the UNO and its components, controlling an

LED light and reading light and temperature sensors. In the process, you will learn how to run JavaScript code on the server with Node.js, build simple circuits, and discover the Johnny-Five JavaScript library to control and communicate with the Arduino UNO and its components.

Arduino connected to a Macintosh

RESTRICTIONS OF THE BROWSER

If we compare it to desktop and mobile applications, JavaScript running in the browser is quite limited. Access to communication ports, hardware Pb_ c ba Ra gf Na Q gUR q YR f l f gR_ NeR NYeRf geVPgRQ+ I UVf level of security is necessary on the Internet as not every website accessed can be trusted, therefore, you need to Ra f heR l bhe Pb_ c hgRe PNa og OR Va q YgeNgRQ Ol _ NYVPVbhf code.

One way to work around the security blocks is to run your application on a server, where you can stream all the required data to the front-end. The server can trust the code running on itself and will grant access to its hardware resources. There are many ways to write server applications, for example, running PHP on an Apache Linux server supported by a database (MySQL, Postgres, etc.), sometimes known as a LAMP stack. Instead of this setup JavaScript can also be used with our own computer as a server.

Communicating with the server traditionally meant sending requests through HTTP and waiting for the server to respond. Around 2005, AJAX appeared making this process a bit more dynamic. AJAX is still just polling the server to load new data, but this time without the need to reload the page. This allowed greater control as the connection and response can be managed using JavaScript.

J fVaTL ROHbPXRgf cebi VQRf N_ beRRs PVRag approach to retrieving data. The protocol makes it possible to open an interactive, two-way communication session between the user's browser and a server. With this API, you can send messages to a server and receive event-driven responses without having to poll for a reply.

The next thing is to build the server that accesses the USB port and handles our Arduino connected to it, an ideal task for Node.js.

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JAVASCRIPT ON THE SERVER

Node.js is built on top of Google's V8 JavaScript engine which can run independently from the browser and on the server.

AR Drone connecting to Node.js

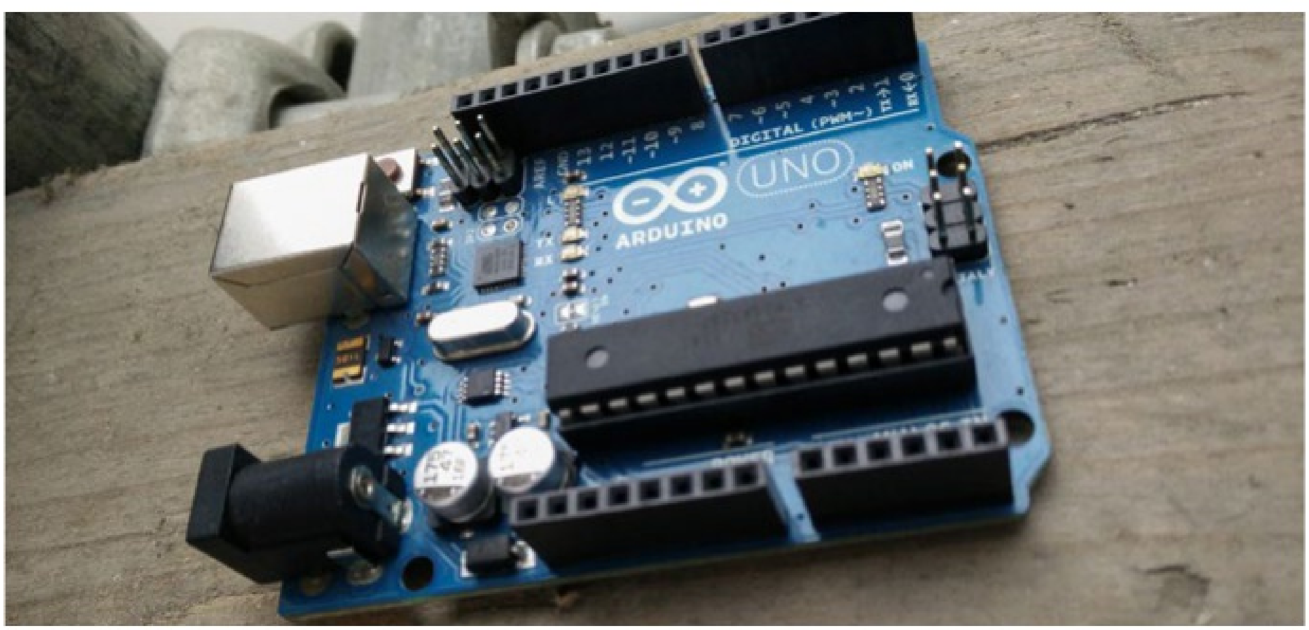
Using JavaScript and Node.js for electronics hacking is not a new endeavour. The community is already using it to power successful projects like nodebots.io, Firmata, Cylon or Johnny-Five. The Node.js ecosystem is even stronger, with over a

hundred thousand packages available via the node package manager (www.npmjs.org). In terms of speed and performance JavaScript has also imporoved quite dramatically in the last decade makes this aspect no longer a compromise.

The event driven, asynchronous properties are also great for working with electronics and sensors, enabling applications that communicate through NFC, RFID or Bluetooth, all of which are currently impossible in the browser. Using Node.js opens up new possibilities for application development using devices like the Xbox Kinect, Leap Motion, midi controllers, drones or smart home accessories like the Nest thermostat or the Philips HUE light bulb.

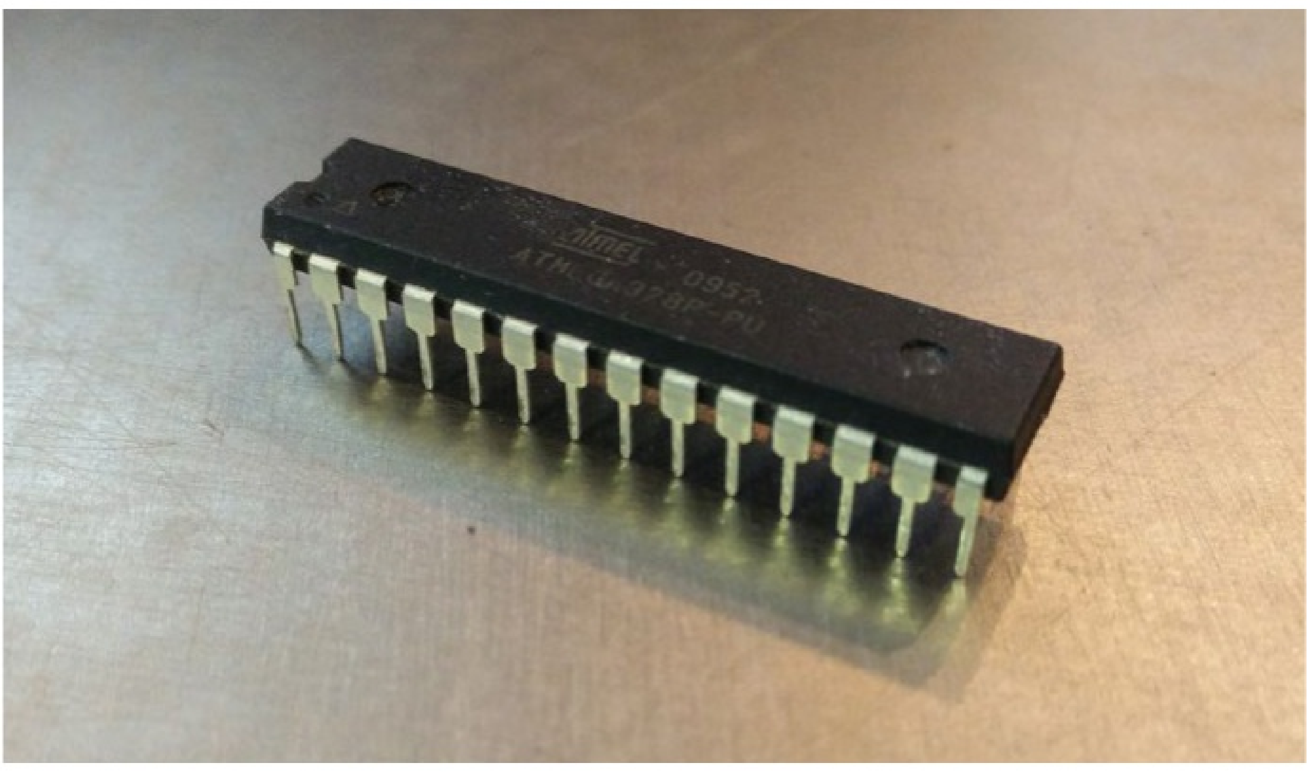
DEVELOPMENT BOARDS

The development board revolution started Nebha Q/--1 j URa gUR q ef g5 eQhVa b j Nf eRYRNfRQ+I UR Arduino project was started by a few Italian university teachers trying to make it easy for students to work with electronic components and program microcontroller chips. Arduino is still by far the most popular platform today.



Arduino UNO development board

The microcontroller is the brain of the board that controls and manages everything. This is a low cost, low power, low performance processor capable of running a single application at a time. The microcontroller is only responsible for managing low-level input and output electrical signals, and performing some basic calculations with them. This chip is capable of switching RYRPgeVPNYPb_ cbaRagf ba NaQ bp)_ RNfheVaT RYRPgeVPVgl from sensors, and interfacing with other components.

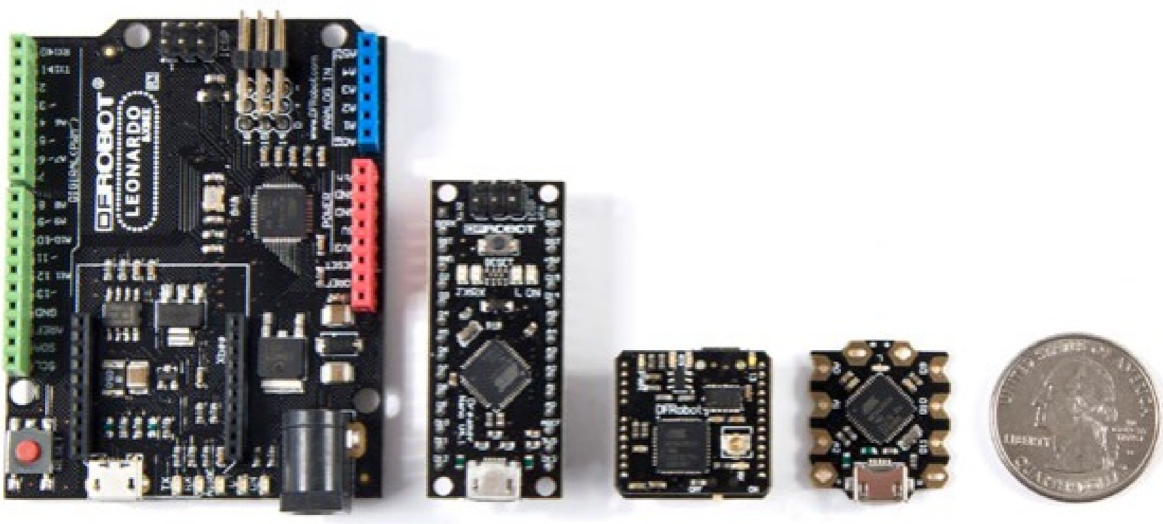


The microcontroller powering the Arduino UNO

These chips can work independently, however, development boards can streamline the building process. They help power, communicate, and interface with the

microcontroller. The addition of a USB port to upload the code on the UNO, and a barrel plug for powering the system from a 9V battery, are both helpful.

Currently, there's an overwhelming number of boards available on the market to choose from. Most of these are Arduino compatible, so how are they all QVp ReRa g Seb_ RNPU bgURe4



H CRCNTL SHCB RBUHNOAOMP THLC O RBS from DFRObot

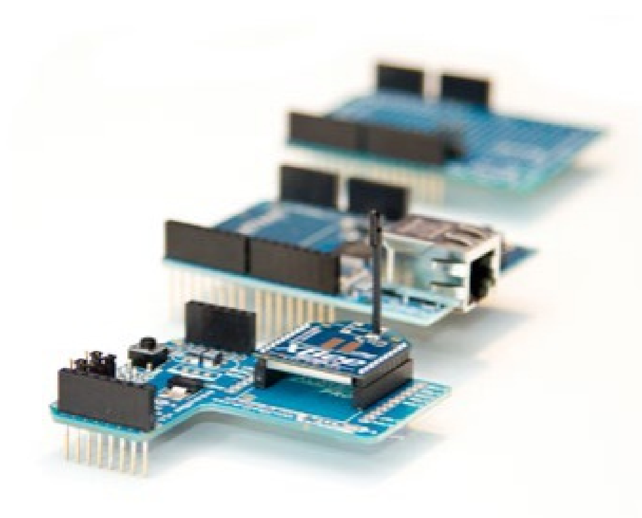
5 f NfgNeg gURl TeRNgYI QVp Re Va f VmR+F a R bSgUR smallest boards available are the DFRobot Beetle and the Tinyduino, which are great for wearable or drone projects where size or weight are important factors. With smaller size you have a stripped down feature set too, and less components, which means less things to power, so they are perfect for battery powered prototypes.

Other boards enable features like Wi-Fi, ethernet or bluetooth connection, while others can act as a mouse, keyboard or other USB controller when plugged into your computer, and there are also boards designed for building home automation, and home security.

Development board for home automation with two realys to switch mains electricity

THE ARDUINO UNO

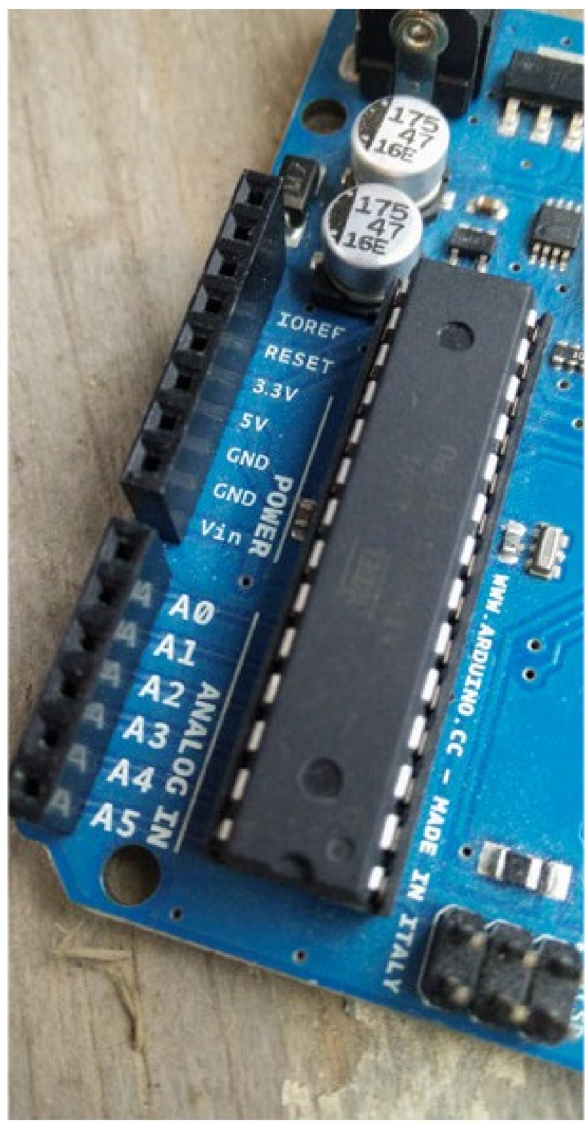
I Ubf R ObNeQf NeR ObgU hf RShYNa Q Np beQNOYR) Ohg the Arduino UNO is still the number one, most popular board to start developing with. One of the reasons might be that its pin layout is clean and spacious, making it beginner friendly. The extra features listed above, like wireless connection, are all possible with UNO projects, though these will require the addition of external modules or shields.



Extension shields for the Arduino UNO

Anatomy of the Arduino UNO

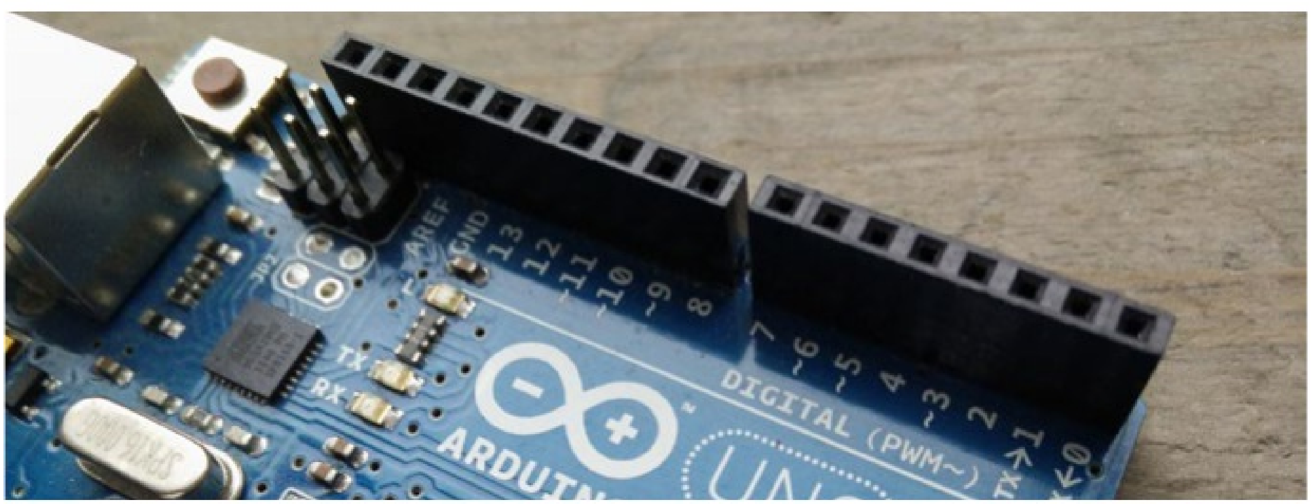
The most important component of the Arduino UNO is the ATmega328 microcontroller chip. This chip manages the input and output pins (GPIO) of the UNO that are exposed through the header pins along the top and bottom edge of the board. In short, input pins (ANALOG IN) are designed to measure electricity from sensors like light, sound or temperature. Output pins (DIGITAL) on the other hand can switch electricity on and bp Sbe YTUgf) _ bgbef be bgURe electronic components. Both the input and output pins can be accessed and controlled from the application code you write and upload onto the board.



Power and input pins on the UNO next to the long microcontroller chip

The header pins also also allow connection to a constant 5V and a 3.3V (5 and 3.3 volts) power source. These will simply let you use the UNO like a battery to power your components. On regular batteries you will qaQgj b cbYRf3cbfVgVi R NaQaRTNgVi R+I UR1K NaQ0+0K pins on the Arduino are the positive poles, GND (ground) pins are the negative ones.

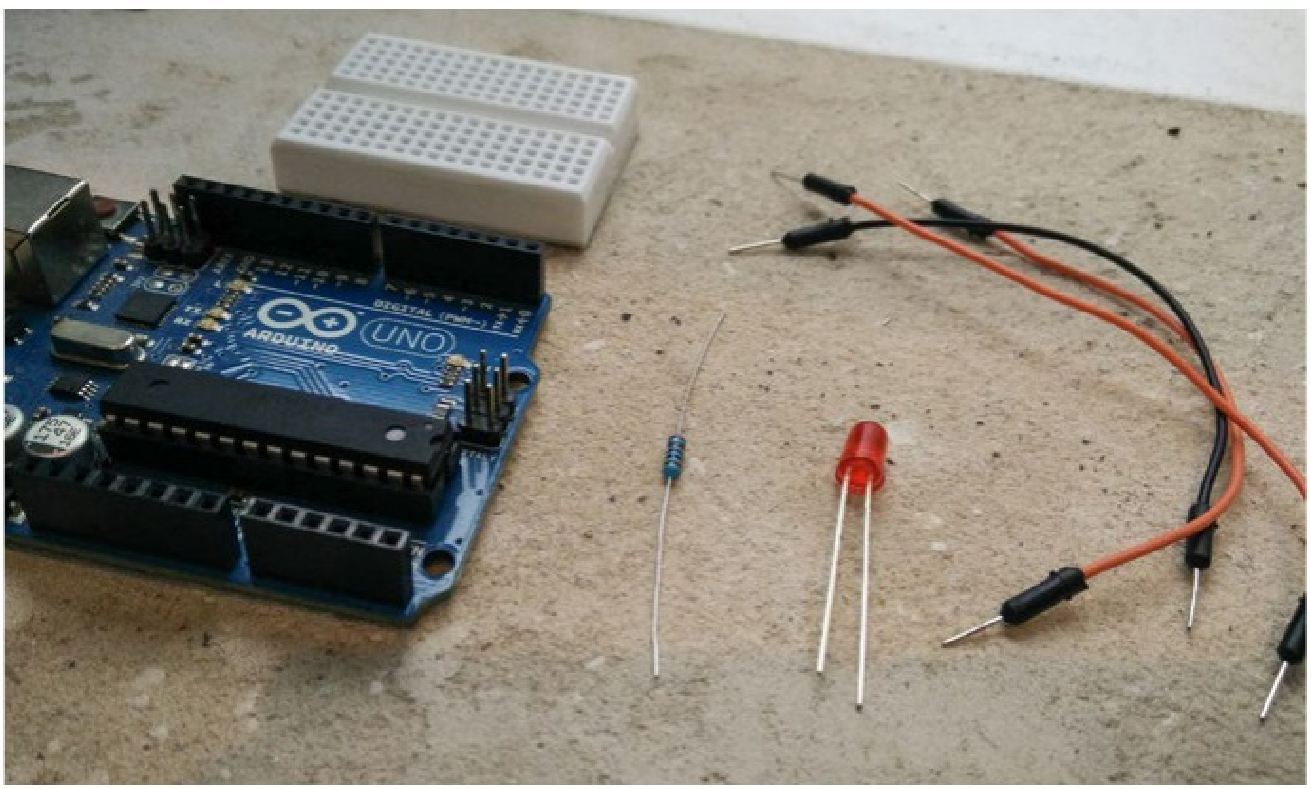
Next to the header pins is the large USB type B port used to communicate with a PC and upload code. The barrel plug on the bottom left is where you can connect a 9V battery or any other DC power source between 6 – 20V (the recommended is 7 –12V), this can be any mains adapter with the correct size of plug and amount of voltage. For the purposes of the following projects, the Arduino won’t be powered from an external source, but will need to be connected via USB to a computer which will in turn power the device.



Digital output pins

The output pins on the Arduino board are also c bj Re f bhePRf) Wf g YWXR gUR 1K c Vaf NeR+I UR QVp ReRa PR ORVa T gUNg gUR bhgc hg c Vaf PNa OR f j VgPURQ ba Na Q bp Ol the microcontroller chip and the application we uploaded and run on it.

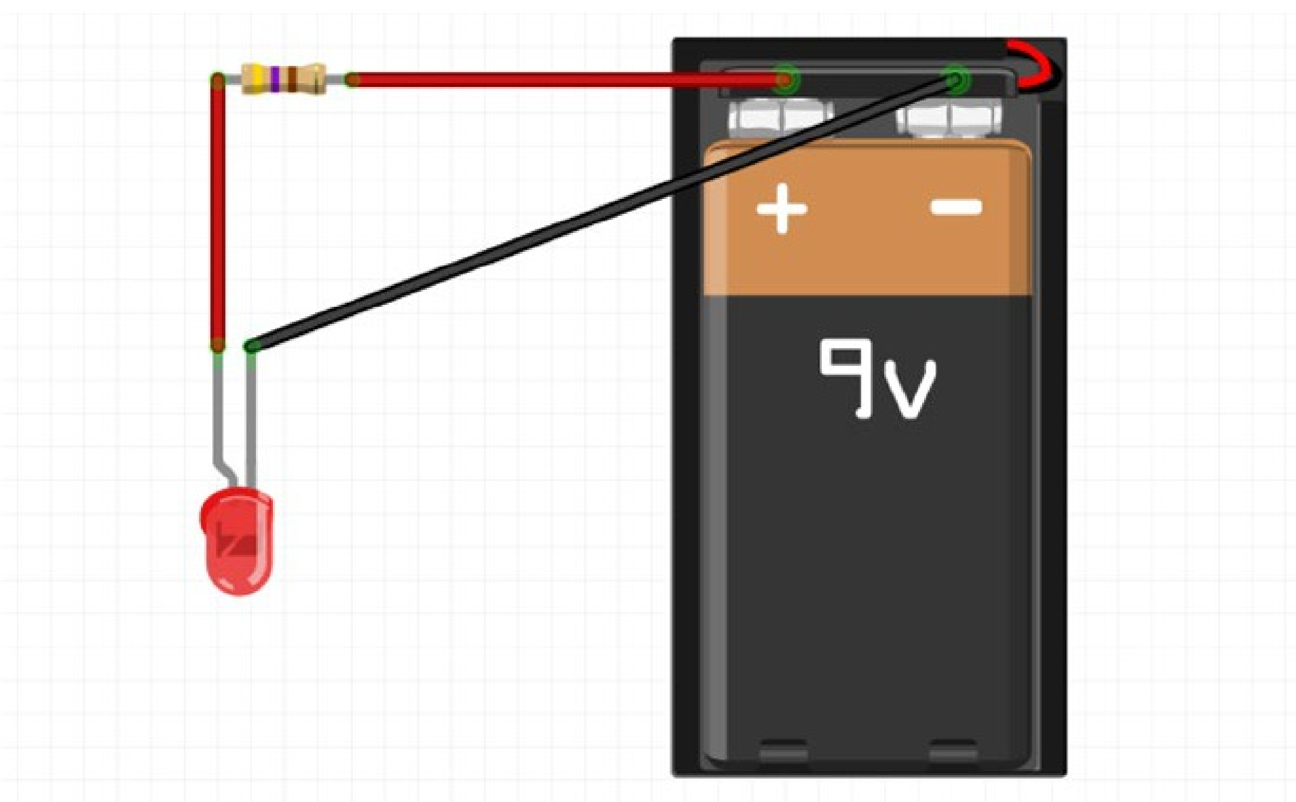
To demonstrate the behavior of the output pins let's build a simple circuit and control it from JavaScript. The "Hello World" of hardware development is blinking an LED, so that's what we are going to start with. For this project you will need an Arduino UNO, a regular LED, a 150 – 1k resistor, a breadboard and a few jumper wires.



Components for the LED blink example

GRfVfgbef PNa OR VQRagVqRQ Seb_ gUR PbYbheRQ stripes on their body. There are many resistor calculators[1] and cheat sheets to help you with that.

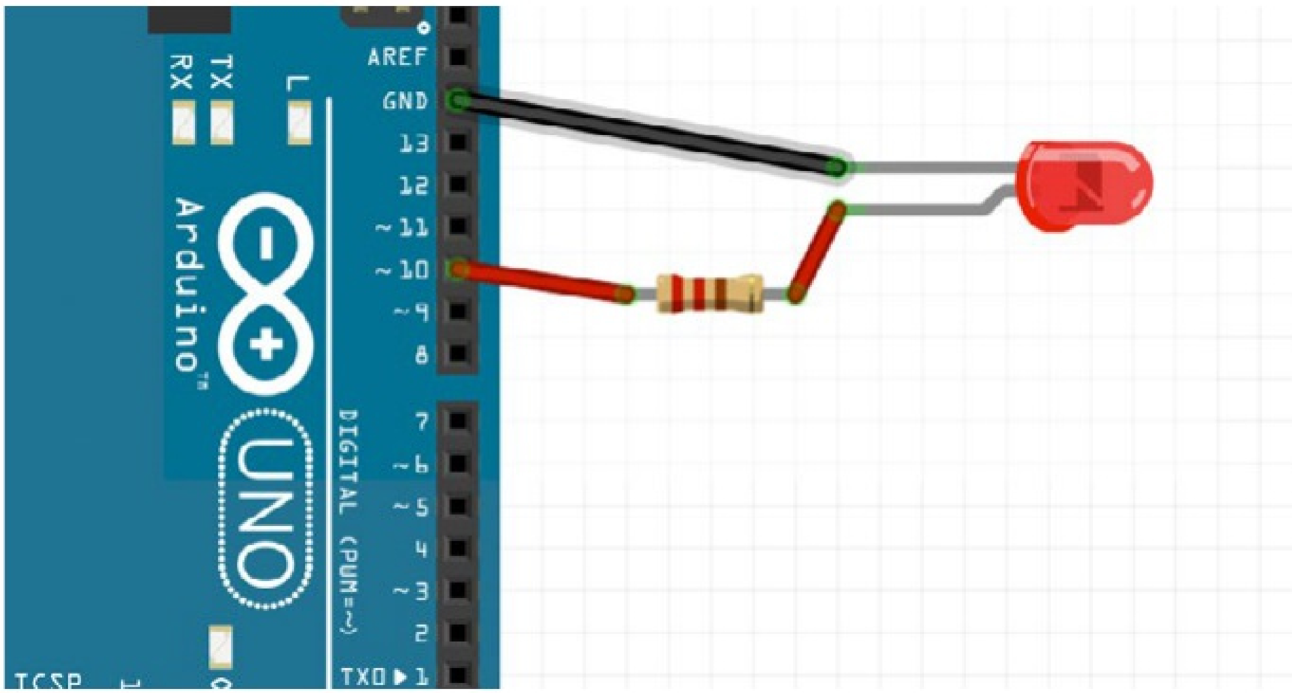
The simplest possible circuit we could think of would be an LED lit by a battery. This circuit connects the positive pole of the battery with the positive leg of the LED and the negative pole with the negative leg. Once they are connected, electricity and electrons start r bj Va T gUebhTU gUR YRQ j UVPU j VYYVa Ri VgNOYl PNhfR Vg gb light up.



TTCR NB N. RHT HNE ORE

[1] http://www.dannyg.com/examples/res2/resistor.htm

Rebuilding this simple circuit on the Arduino will essentially mean replacing the positive pole of the battery with the 5V pin or one of the output pins on the Arduino and the negative pole with GND. In this example, I randomly picked output pin number 10.



. AONNCATCB TO TFC RBUHNO OUTPUT PHN RT HNE ORE

This circuit is already complete and by switching the 10th output pin on from our program code the LED would light up.

You probably noticed the addition of a small resistor to the circuit and wonder why we need this. L RYY) gUReRof ba R c ebOYR_ 3gUR D87 QbRfa og YV_ VggUR electric current in our circuit so without it would try to use too much of it. With no resistor in our circuit we

would over drive and damage our LED in a short amount of time. It would probably only work for a couple of minutes before burning out irreversibly.

To prevent this from happening, we can limit gUR r bj bSRYRPgeVP PheeRa g gUebhTU gUR D87 Ol NQQVa T a resistor. Using [ohm’s law](#)[1] (Resistance equals voltage divided by current or R = V / I) we can calculate the exact resistor needed in a certain setup.

In our circuit the Arduino provides 5 volts but not NYbS gUNg j WYTb bi Re gUR eRf Vf gbe3 gUR D87 NYf b UNf N/ volts voltage drop which is the ideal supplied voltage for it to work. We also know that the ideal current for our LED is 20mA or 0.02 in Amperes. Now we need to choose a resistor which will drop that voltage at 20mA. The right i NYhR Vf TVi Ra Ol F U_ of YNj 3

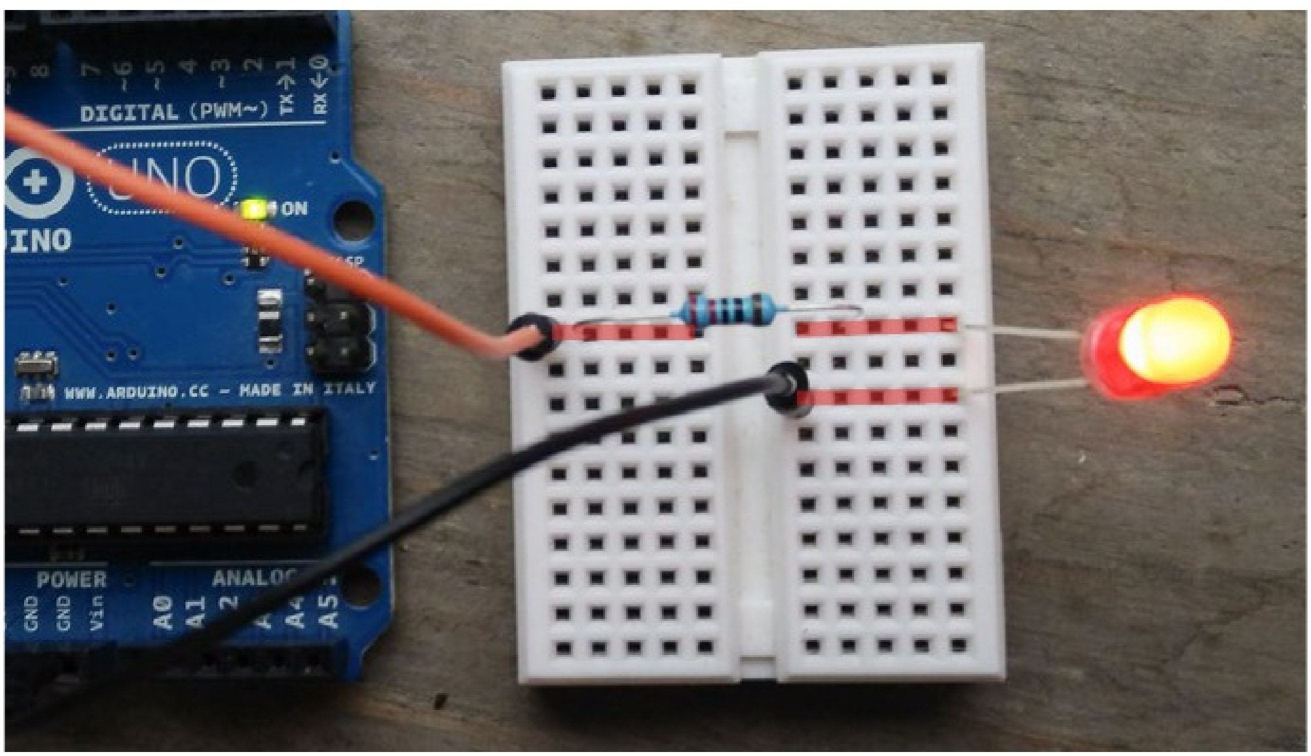
```
R = V / I
R = (5V - 2V) / 0.02A
R = 150Ω
```

I UVf _ RNa f gUNg j R a RRQ NeRf Vf gbe Nebha Q .1−n + Mbh Qba og j Na g NeRf Vf gbe gUNg of YRf f gUNa .1−n Ohg hf VaT N YNeTRe ba R) Sbe RkN_ c YR//−n)1−−n be .−−−n)j bhYQ eRf Vf g gUR r bj Ri Ra SheegURe) j UVPU j bhYQ _ NXR bhe D87 more dim, but would extend it’s lifetime in return.

[1] : FFCE- JBGFG 58 / 0HF. G

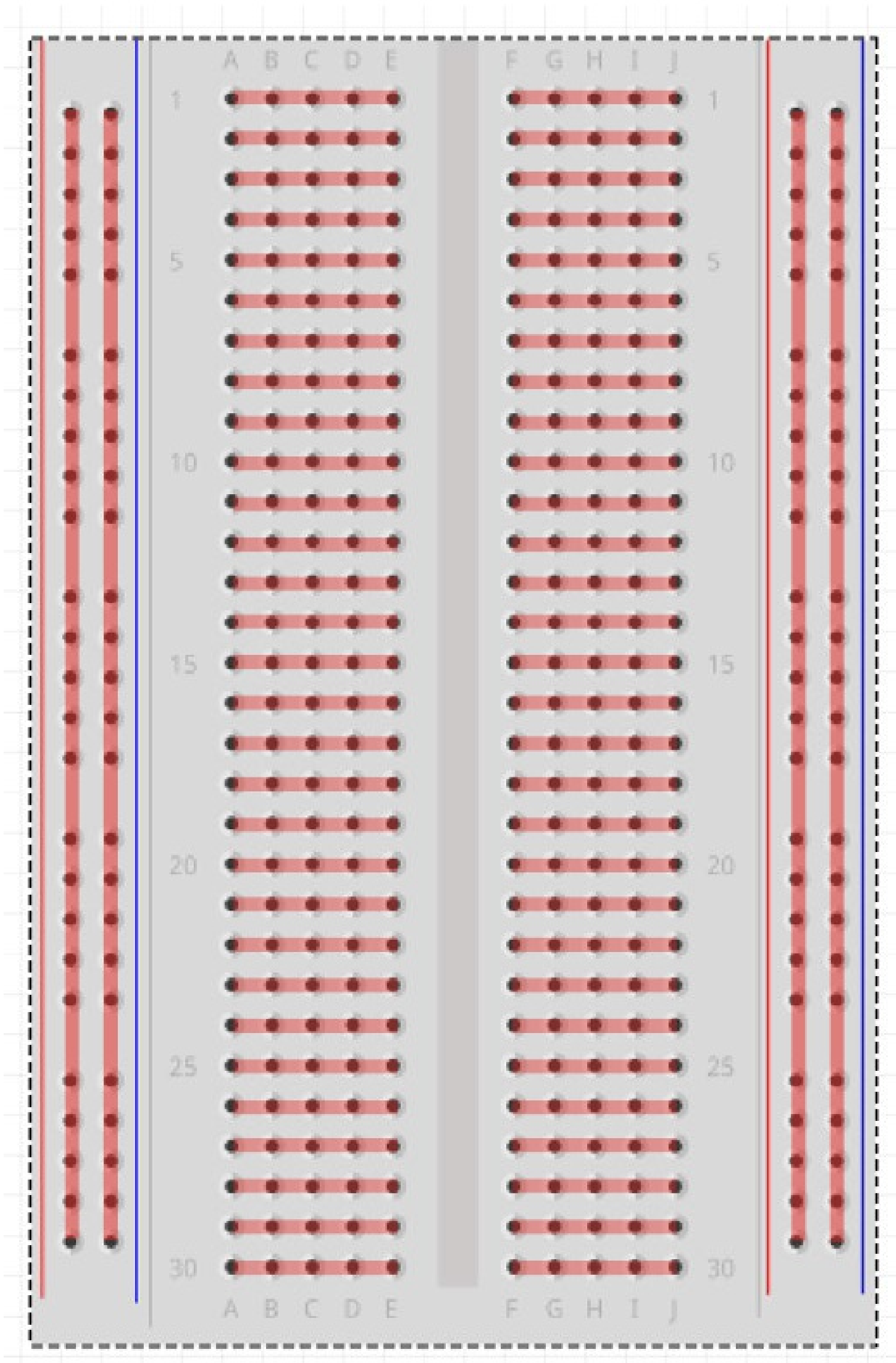
Prototyping breadboards

Breadboards make it easy and quick to build circuit prototypes. They are designed to take regular male to male jumper wires or the legs of simple components like LEDs, resistors, diodes or capacitors. Broadboards esenttialy help with connecting these components together. When you stick the leg of an LED anywhere in the breadboard components added to the same pin row will be connected to the LED.



LED circuit connected inside the breadboard

Here is a larger breadboard with all its pin
Pba a RPgVba f UVTUYVTUgRQ3



Connected pins on a large breadboard

STARTING OFF WITH NODE.JS

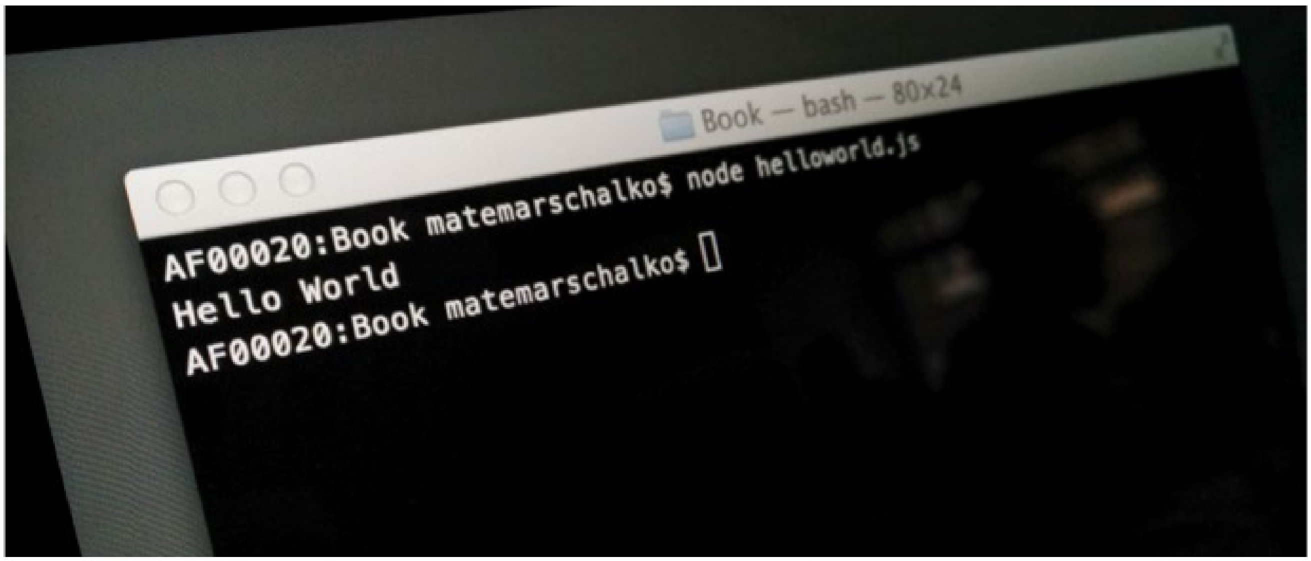
I UR D87 Vf abj eRNQl gb ORfj VgPURQ ba NaQ bpp using JavaScript. To do this we will need to run JavaScript on the server, in order to have access to the USB port gUNgj Rj WYPbaaRPggb gUR5eQhVab+I UR qefgfgRc Va gUVf journey is to install the Node.js environment onto the computer.

Installing Node.js is a quick and easy process, and PNa ORQbaRj VgU gUR bs PVNYceR*OhVYg VafgNYYRef+Mbh PNa download these from Uggcf3,,abQRWf+beT,Qbj aYbNQ,.

Once installed, the new node command is available from the Terminal on OS X or the Command Prompt on Windows. For a Hello World demonstration PeRNgR NaRj qYR PNYYRQ URYYbj beYQ+Wf NaQ NQQ gUVf fVaTYR YVaRbSBNi NHPeVcg gb Vg3

```
console.log(”Hello World”);
```

Entering `node helloworld.js` to your command line tool from the same folder that contains the file helloworld.js, will run the JavaScript file and output "Hello World" to the command line.



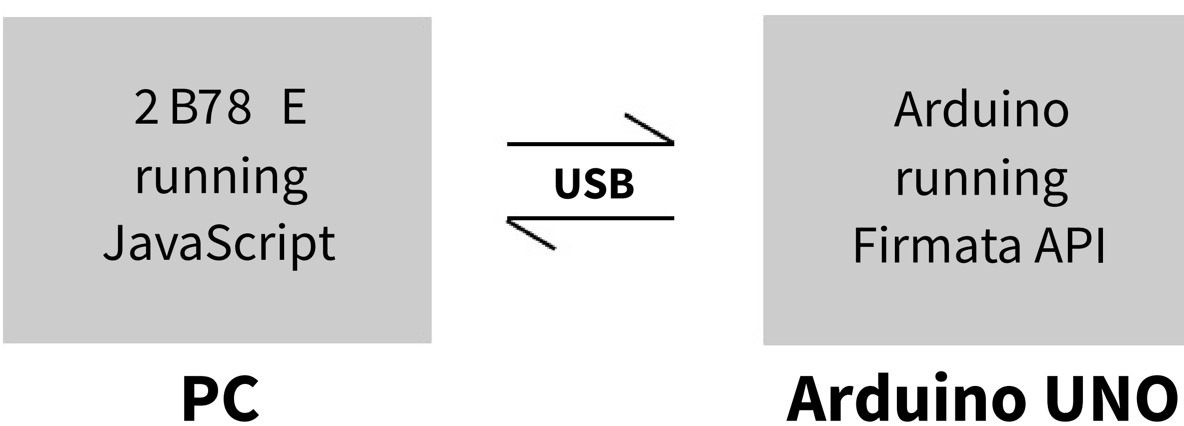
Node.js "Hello World"

This might not seem too much progress so far, but with Node.js setup we are ready to start building our hardware projects using JavaScript. From this environment, we now have access to the USB port, sensors and many other components on our computer.

Connecting Node.js to the Arduino

For this app we will be using the Johnny-Five JavaScript library[1] designed for Node.js. This library was created by the team at Bocoup,[2] to make hardware prototyping easier for web developers.

Running JavaScript code straight on development boards only works with a handful of models and unfortunately, the Arduino is not one of them. Arduinos require you to write code in the Arduino language, and this currently can’t be changed. Johnny-Five, and many other Node libraries work around this limitation by installing Firmata onto the Arduino, which essentially

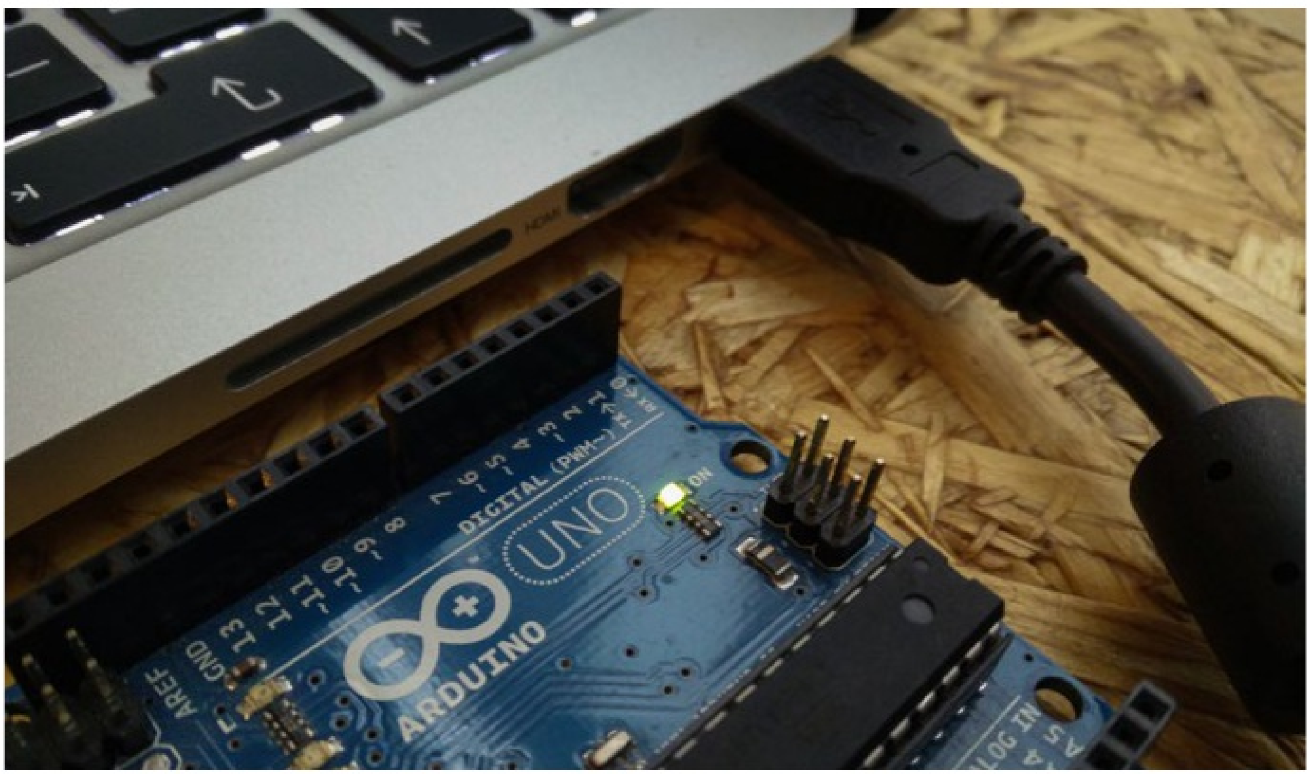


HRM T DORI O

[1] : FFCE- 9 F: G5 6B DI 4 7DBA B: AAJ LH8
[2] https://bocoup.com/

exposes an API to communicate with and control the Arduino from external devices.

I b _ NXR gUR D87 OYWaX)j Rqefg a RRQ gb hcYbNQ the Firmata library onto the Arduino UNO. To upload any code onto the board we need to download and install gUR bs PWNY5 eQhVab A7 8 Seb_ gUR [Arduino website](#).[1] The Arduino IDE is just the name of the application you use to write and upload the Arduino code to the boards.



The Arduino UNO is powered up from the USB port

Once it's installed, plug in your Arduino into the USB port and the green power LED, labelled ON,

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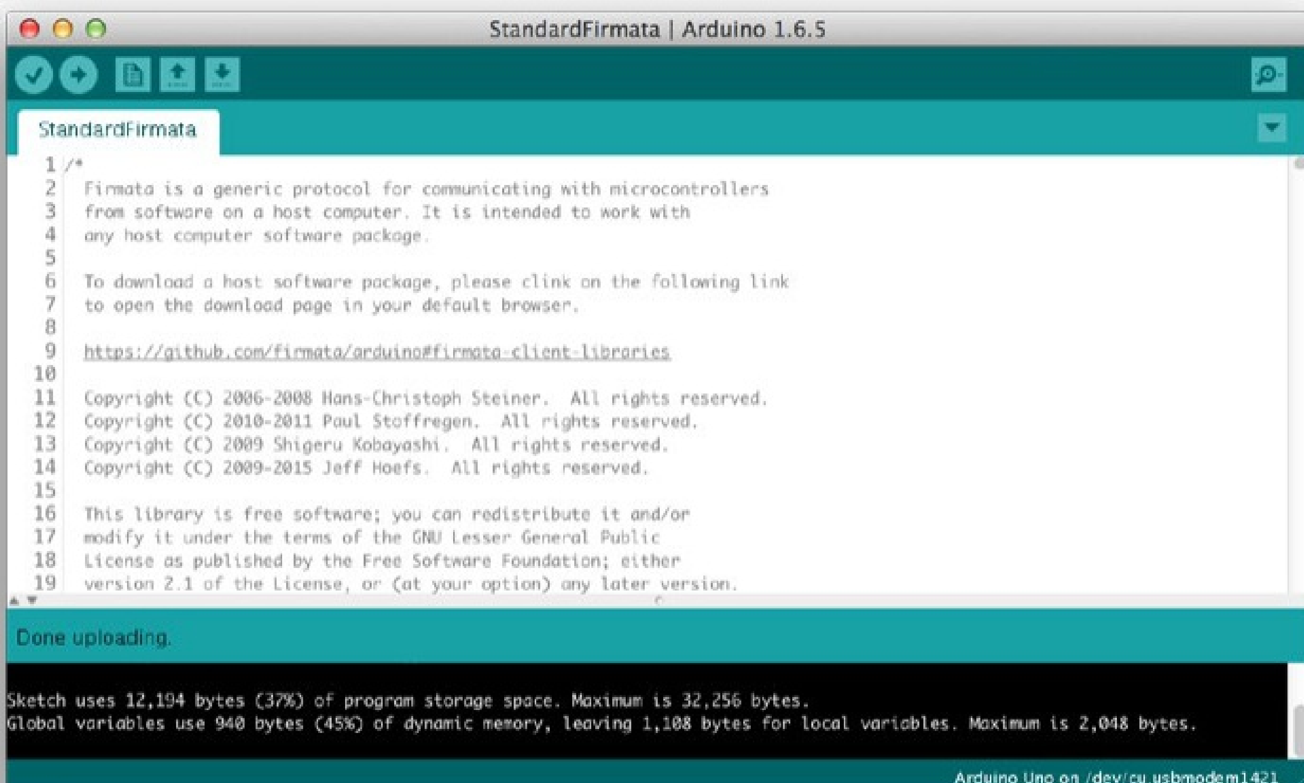
[1] : FFCE- I I I 4D7G AB 66 8A 1 4 A 3BMI 4D8

should light up. Open up the IDE application you just installed and make sure under Tools/Board Arduino UNO is selected. You will also need to select the USB port the Arduino is connected to under Tools/Serial Port. The port will only show up in the list when the board is actually connected. If you have problems getting the environment ready please refer to the bs PWNY installation guide[1] or the troubleshoot page[2].

Below is what you will see when you open up the IDE. At this stage we won't be writing anything in



Arduino IDE with the Firmata sketch uploaded

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[1] https://www.arduino.cc/en/Guide/HomePage

[2] https://www.arduino.cc/en/Guide/Troubleshooting

Arduino language. We only opened the IDE to upload the standard Firmata library. Select File/Examples/Firmata/StandardFirmata to open the sketch then hit upload (the green arrow pointing to the right), this will upload the Firmata library to your UNO.

If everything was successful you will see the "Done uploading." message in the green status bar. If you get an error message, make sure the Arduino is connected, has power, and that the correct board and port is selected in the Tool menu.

If you had any problems installing the Firamata library, please refer to this great instructables guide[1].

[1] http://www.instructables.com/id/Arduino-Installing-Standard-Firmata

BLINKING AN LED

The wiring is already completed and the Arduino has the Firmata library loaded. The UNO is now ready to take commands from Node.js.

Feel free to download the source code of all the examples from www.webondevices.com/download-source/ if that's how you prefer following along.

As we will be using the Johnny-Five library to blink our LED, let's now install it. Make sure you create a new folder and navigate to it from the command line ORSbeR ehaa Va T gUR Vafg NYYNgVba Pb_ _ Na Q ORYbj 3

```
npm install johnny-five --save
```

DRgof NYfb PeRNgR Na Rj q YR Sbe bhe E bQR+W/ Nc c YWPNgVba Na Q a N_ R Vg OYWa X+W/+ I UR q efg gUVa T j R a RRQ to do is load all the libraries into variables required by bhe Nc c YWPNgVba +Aa bhe PNfR Vgof ba Y IbUa a l *9Vi R3

```
var five = require("johnny-five");
```

Next we initialise a new Board instance that will cebi VQR hf NYgUR_ RgUbQf gb VagReNPgj VgU gUR 5eQhVab3

```
var arduino = new five.Board();
```

When working with jQuery we use the `$(document).on("ready", callback);` event listener gb j NVg Sbe gUR QbPh_ Rag gb qaVfU YbNQVaT ORSbeR j R Qb anything else. The Arduino, and the USB connection also need some time to start up, so we will a need to implement a similar event listener before we send our commands.

```
arduino.on("ready", function(){
    // The board is ready
    // We can now blink the LED
});
```

I b OYVaX gUR D87)j Rj VYq efgY aRRQ gb PeRNgR Na D87 VafgNaPR VafVQR gUR PNYONPX bSgUR Ri Rag YVfgRaRe3

```
// Create an LED on pin number 10
var led = new five.Led(10);
```

Then below it, we can just call `blink()`3

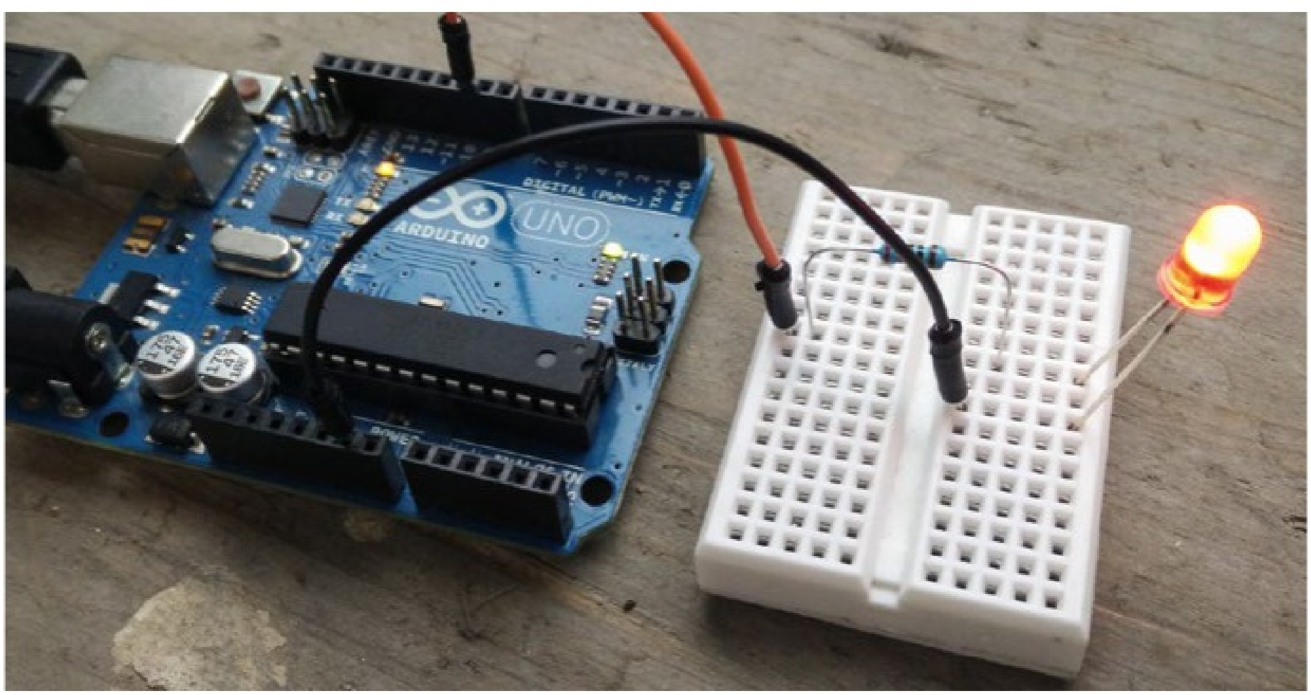
```
// Blink the LED every half second
led.blink(500);
```

= ReRof gUR Pb_ c YRgR OWa X f XRgPU Va ba R3

```
var five = require("johnny-five");

var arduino = new five.Board();

arduino.on("ready", function(){
    var led = new five.Led(10);
    led.blink(500);
});
```

Now that the LED is setup we can try other
_ RgUbQf gbb3 `led.pulse();` will fade the led in and
out instead of just switching with no transition.
6bai Ra VRa gYl) SNQR Va Na Q bhg_ RgUbQf NeR NYfb Ni NWYNOYR3

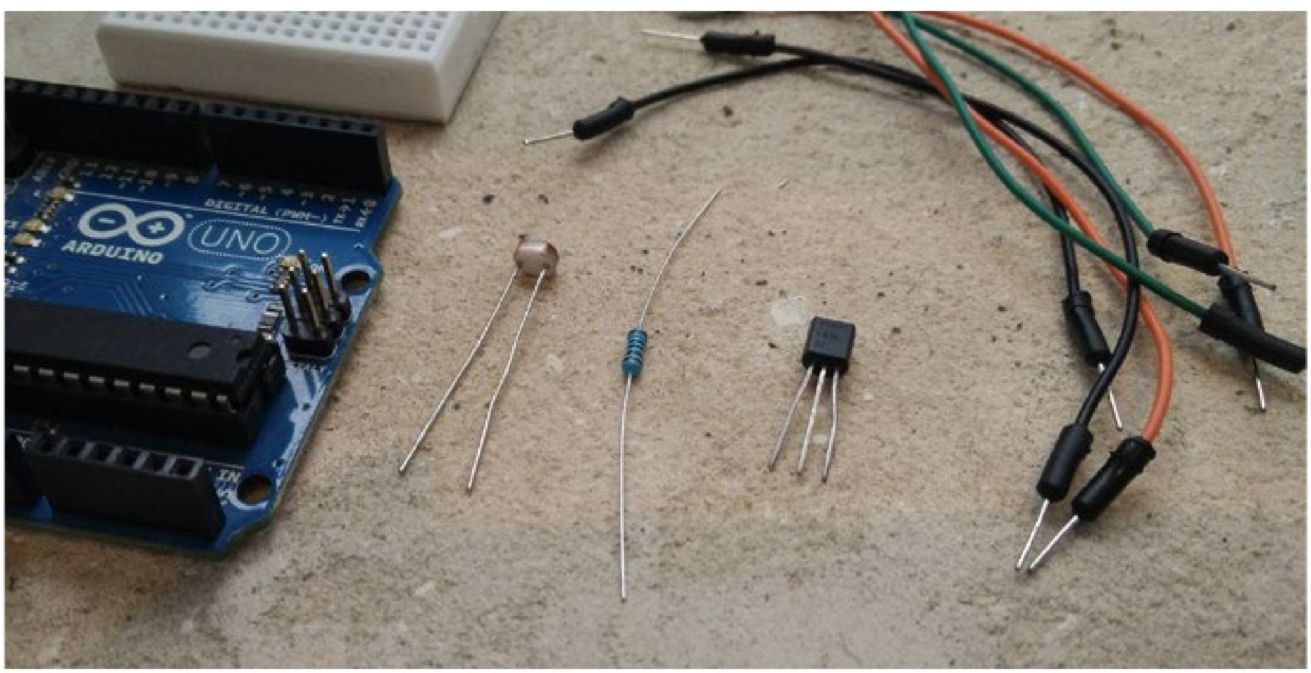
```
// fade led in
led.fadeIn();

// wait 3 seconds then fade out
this.wait(3000, function(){
    led.fadeOut();
});
```



Blinking an LED from output pin number 10

SENSING THE WORLD

In this chapter, we will extend our knowledge by exploring the input pins. We already know that these pins can measure the change in voltage so we will use f V_ c YR Na NYbT f Ra fbef gUNg Np RPg gUR i bYgNTR ehaa VaT through them depending on certain changes in the environement.



Components for the sensor projects

For this project, you will need an Arduino UNO, an LM35 or TMP36 temperature sensor, an LDR, a breadboard, a two 1k resistors and a few jumper wires.

Measuring temperature

For measuring temperature I picked the very common LM35 sensor. This low cost sensor is rated to operate between -55 and 150°C, with a +/- 0.5°C accuracy (although it's a little bit tricky to measure minus temperatures with the LM35). The way this analog sensor works is really simple and in fact, most analog sensors work in a similar way. First they are powered from a constant power source on two of their pins (+ and -), then, on a third pin, they output a lower voltage value that is directly proportional to the sensor reading.

Our temperature sensor will be powered from the Arduino UNO's 5V pin and will output voltage values between 0 volts and 2 volts, changing with the temperature. The LM35's scale factor is 0.01V/°C, meaning that 1 celsius degrees change in the air temperature will result in a 0.01 volt change on the output pin.

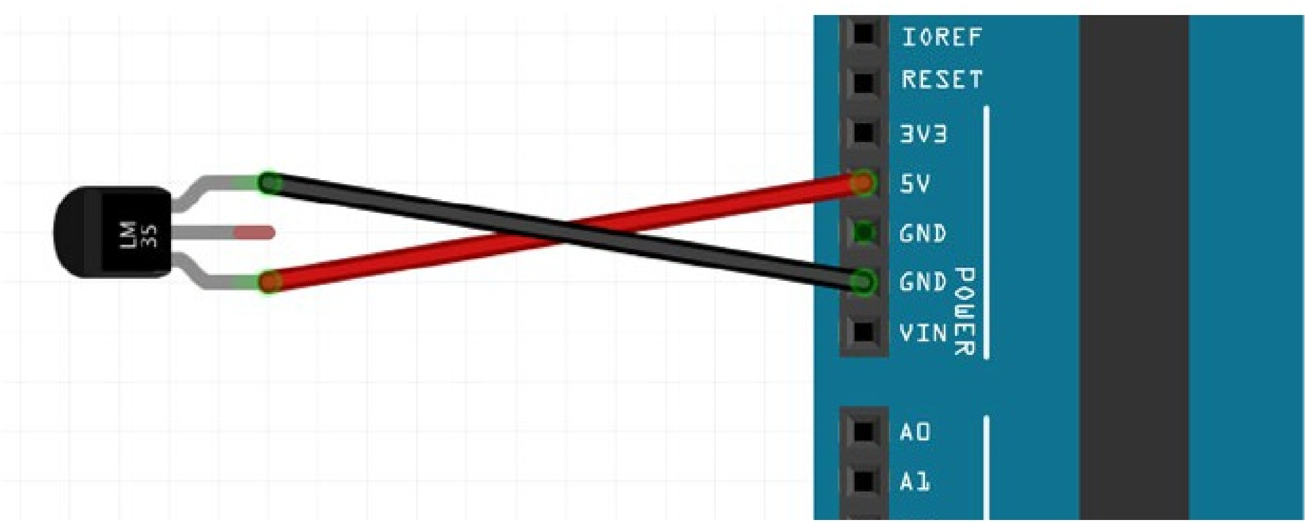
Conveniently, the Arduino's analog input pins are designed to measure and convert voltage into data we

can use. In actual numbers the full range of 0 to 5 volts that can be interpreted by the analog pins of the Arduino UNO will be mapped to a 0 – 1024 scale in our program code.

Let’s say your sensor returns only 1.5 volts from the supplied 5 volts to the analog input pin you connected it to. The reading in your application will be 307 on the 0 – 1024 scale because (1.5 / 5) * 1024 is 307.2.

The Johnny-Five library then maps the 0 – 1024 measurement scale to the sensor’s -55 to 150°C range then calculates the resulting temperature from this information.

Let’s go back to our temperature sensor and wire it up. Before you start wiring, always make sure you have unplugged your Arduino from the USB, or any other power source. Otherwise you could accidentally stick a

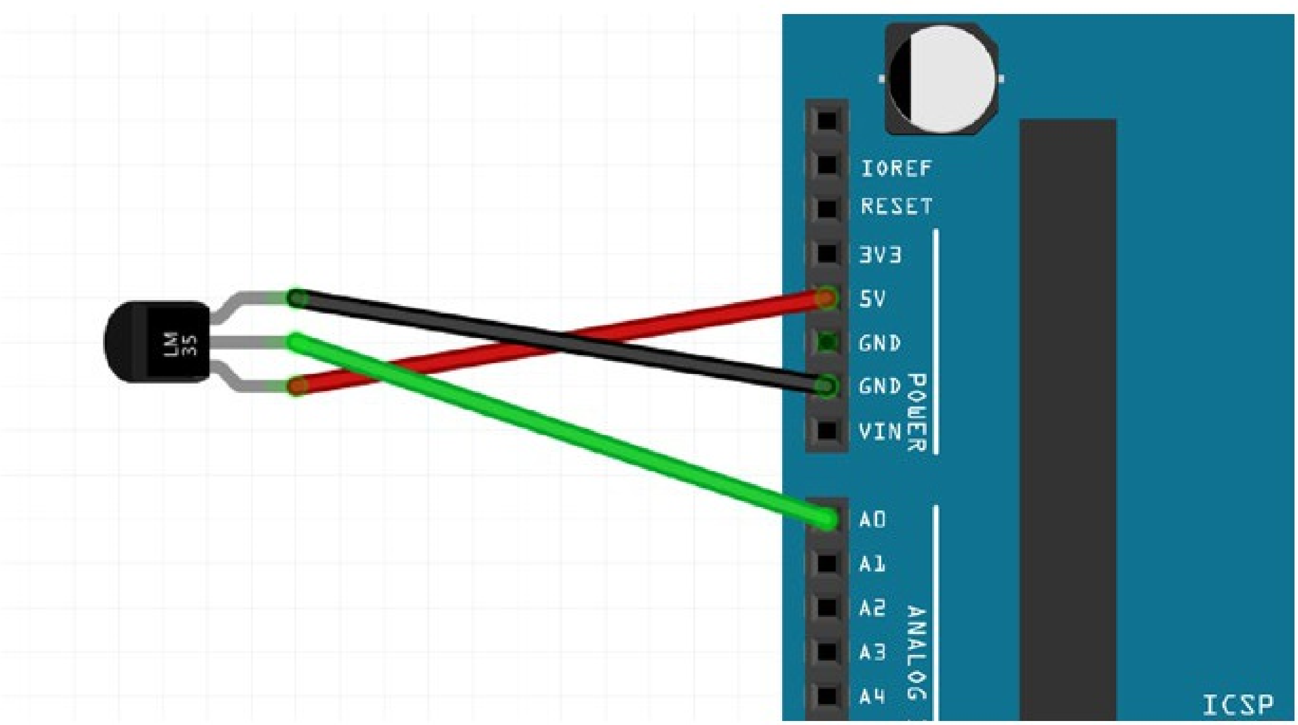


1CM PCR TURC SCNSORPO CRCB RFT HNE ORE

wire into the wrong header pin that could damage your board, or the sensor.

From the three legs of the sensor the one on the left is the positive, and the one on the right is the aRTNgVi R cbYR!gUR r NgfVQR bS gUR fRafbe Vf gUR Sebag(+ We will feed the power in from the 5V (positive) and GND (negative) pins of the Arduino UNO as seen on the previous page.

The sensor is now powered, and the only pin left is the output. This will need to be connected to one of the qiRNaNYbT cVaf ba gUR J E F +I URfR NeR gUR baRf YVaRQ hc along the bottom right edge of the board, marked A0 to 51+DRgof Pbaa RPgVg gb cVa 5 -3



Temperature sensor connected to an
N LOE HNPUTPHN ODTFC RBUHNO 0 RHT HNE ORE

Ebj gUNg gUR j VeVa T Vf q a VfURQ) YRgof j eVgR gUR script that will read the sensor. Firstly, create a new cebWRPg NaQ aN_ R gUR_ NVa q YRgR_ c+W) fgNegVaT Vgbp gUR fN_ Rj Nl Nf gUR OYVa X fXRgPU3

```
var five = require("johnny-five");

var arduino = new five.Board();

arduino.on("ready", function(){
    // The Arduino is ready
});
```

Next, we need to create a new Temperature sensor instance with a few settings, which are the name of the sensor, and the pin number it's connected to.

```
var tempSensor = new five.Temperature({
    controller: "LM35",
    pin: "A0"
});
```

If you have a TMP36 sensor that can still be used the same way. Simply change the controller settings to TMP36 and the wiring is the same.

After initialising the temperature sensor we can start using the on data event listener to catch sensor readings as they arrive. The Johnny-Five library leverages the asynchronous capabilities of Node.js which means that sensor readings immediately appear in the on data event listener's callback function. Let's write gUVf Ri Ra g YWf gRa Re3

```
tempSensor.on("data", function(er, data){
    console.log(data.celsius + "°C");
    console.log(data.fahrenheit + "°F");
});
```

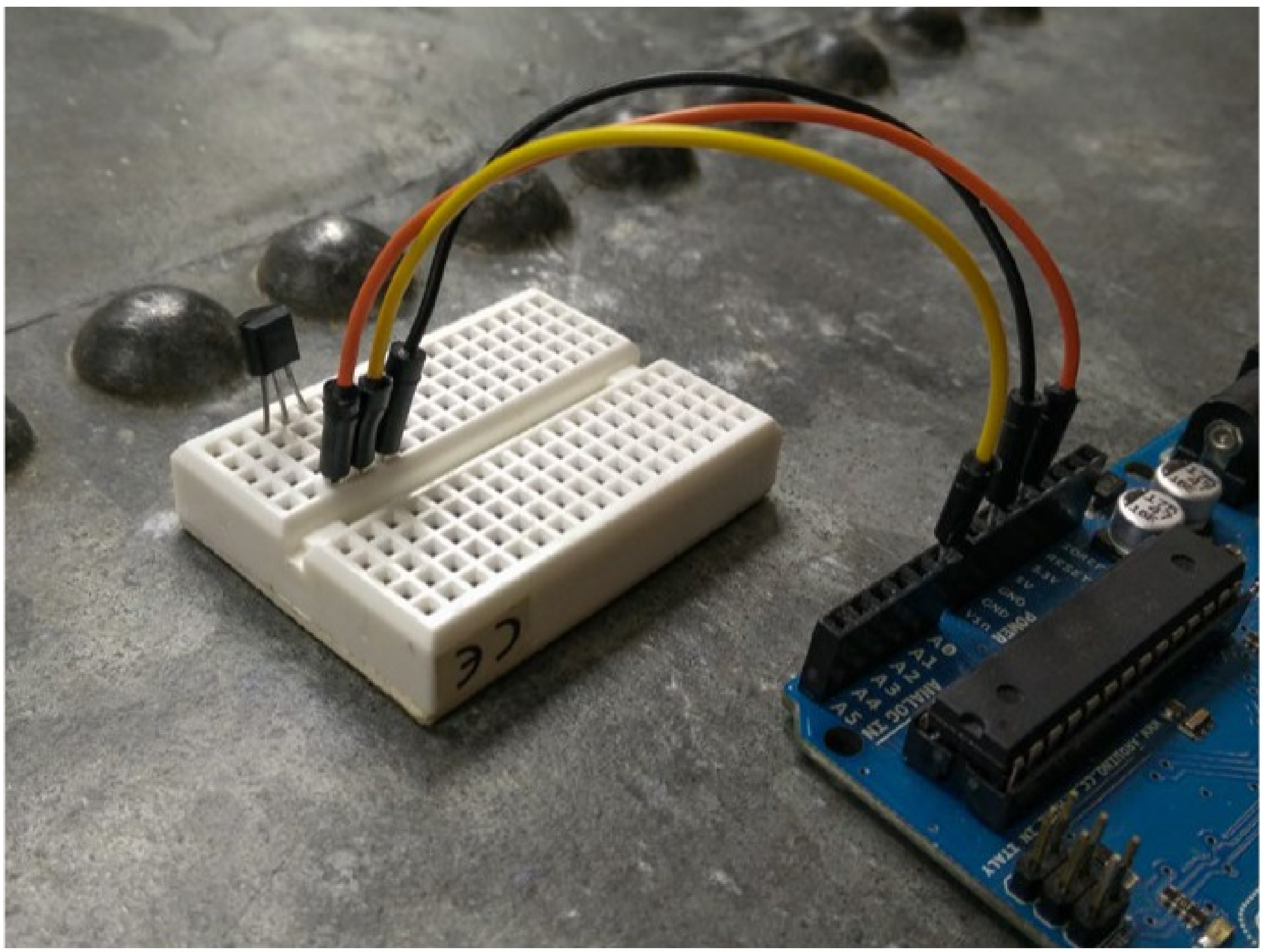
Again, we need to wait for the board to be initialised so both of these blocks will need to go into the `arduino.on("ready", callback);` function.

Aa gUR q a NYi Ref Vba bS gUR f PeV:c g Sbha Q ba gUR next page, both the celsius and the fahrenheit sensor readings are rounded to one decimal places to make the numbers easier to read.

```
var five = require(”johnny-five”);

var arduino = new five.Board();

var celsius = 0;
var fahrenheit = 0;

arduino.on(”ready”, function(){

var tempSensor = new five.Temperature({
    controller: ”LM35”,
    pin: ”A0”
});

tempSensor.on(”data”, function(er, data){
    celsius =
        data.celsius.toFixed(1);
    fahrenheit =
        data.fahrenheit.toFixed(1);
    console.log(celsius + ”°C”);
    console.log(fahrenheit + ”°F”);
});

});
```

Run your script by typing `node temp.js` into the command line tool. Check the readings, and if there are anomalies, double check your wiring, make sure the Arduino is connected to the USB port, and the green power light is on. If all is good, we can move on to the light sensor.

Here's the LM35 temperature circuit added to a f_ NYYOeRNQObNeQ3

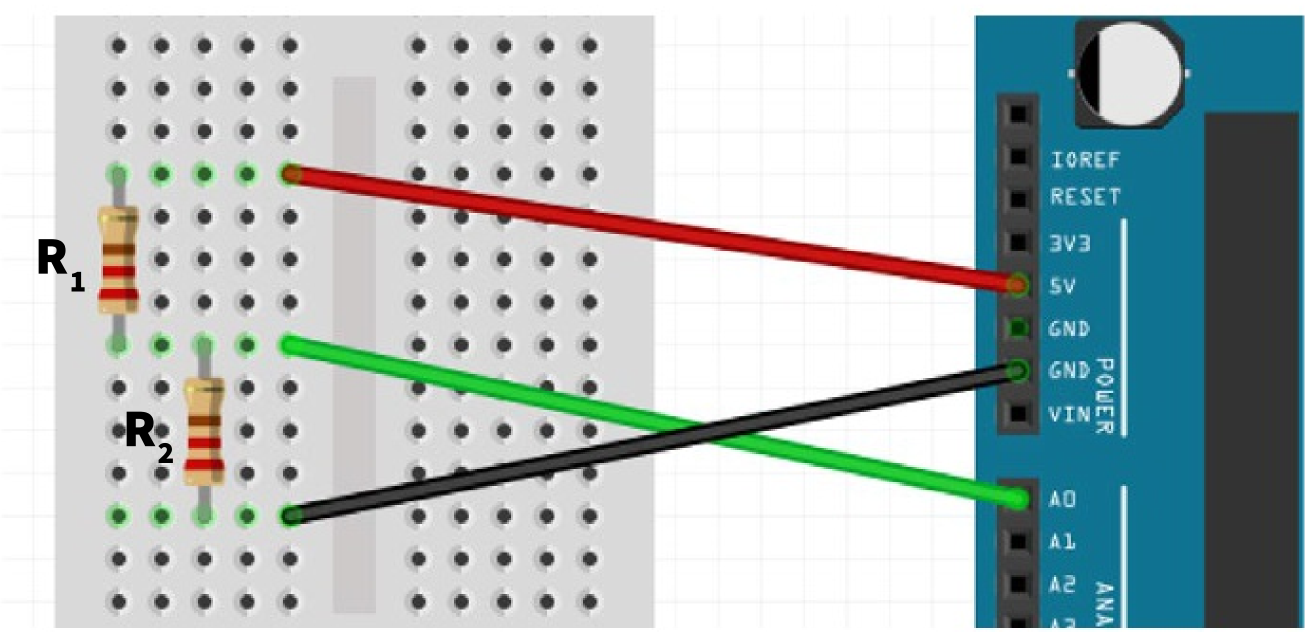


Temperature sensor circuit on a breadboard

Measuring light

Our light sensor is one of the simplest sensors available, known as an LDR, meaning Light Dependant GRf Vf gbe+5 a D7 G NPgf YWXR NeRThYNe eRf Vf gbe gb gUR r bj bS PheeRa g+I UR _ NVa QVp ReRa PR Vf gUNg gUR D7 G PUNa TRf Vgf resistance depending on the light conditions.

Unfortunately resistance isn't easy for the analog Va c hg q RYQf bS gUR 5 eQhVa b gb _ RNf heR+I b Pba i Reg gUVf resistance change into voltage change, that the input q RYQf NeR _ beR Pb _ SbegNOYR _ RNf heVaT) j R a RRQ gb OhVYQ a simple voltage divider circuit. A voltage divider circuit splits a larger voltage into smaller ones with the ratio of gUR gj b eRf Vf gbef 3



OLT EC BHWHBCR RFT HNE ORE

The 5 volts input of this circuit comes from the Arduino through the red wire. The output voltage through the green wire is directly proportional to the input voltage and the ratio of the resistors (R_1 , R_2).

$$V_{out} = V_{in} * (R_2 / (R_1 + R_2))$$

Aa gUVf PVePhVgj RhfRgj b .---n eRfVfgbef fb UReRof Ubj gUR RdhNgVba YbbXf YVXR j VgU gURfRi NYhRf3

$$V_{out} = 5V * (1000 / (1000 + 1000))$$

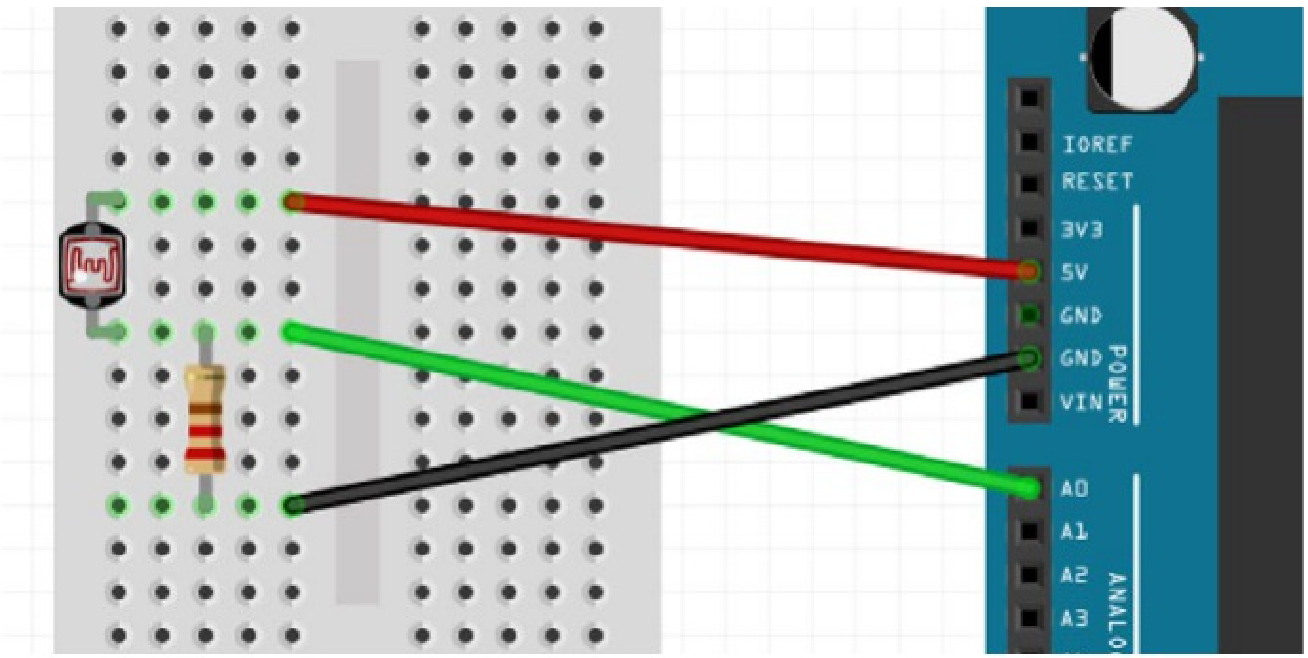
$$V_{out} = 5V * 0.5$$

$$V_{out} = 2.5V$$

This means that if two of the same resistors are used in a voltage divider circuit the output voltage will be half of the input voltage. 2.5 volts in our case. Using the equation we also see that changing only one of the resistors will change the output voltage up or down.

In the LDR circuit we change one of the regular resistors to the light dependent resistor. The resistance of the LDR will change with the light conditions in the voltage divider circuit which in return will constantly change the output voltage for our input pin.

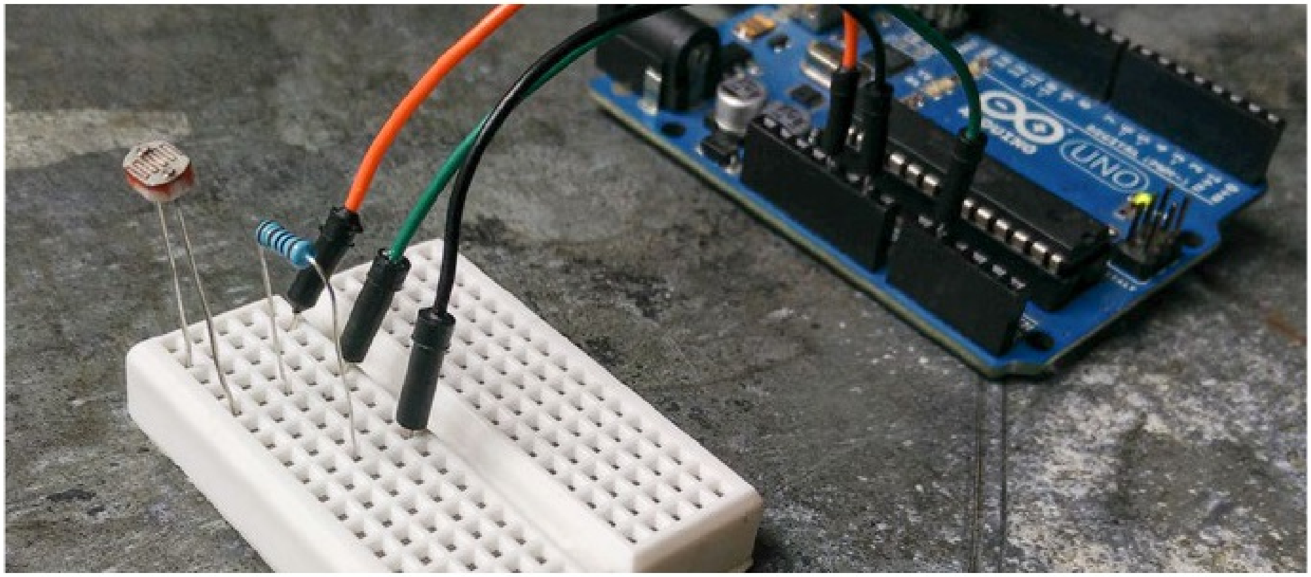
When the photoresistor is exposed to light, its resistance decreases so the voltage reading will be higher. Conversely, with less light the voltage reading will be lower. The changing voltage value is then what the analog input pins of the Arduino factor to calculate the measurements.



. HEFTSCNSORAHRAUHT RHT HNE ORE

The light dependent resistor changes its eRfVfgNaPRORgj RRa .1-n Va OeVTUgYVTUgNaQ 2---n Va QNeX+CRRcVaTgURbeVTVaNYqkRQ .---n eRfVfgbeVaNaQ using the voltage divider equation we can tell that our output voltage will change between 4.35V and 0.5V which is a great range for the Arduino's input pin.

Here's how this circuit looks like on the OeRNQObNeQ3



. HEFTSCNSORAHRAUHT RHT HNE ORE

The circuit is all done so let's add the light sensor to our JavaScript app into the arduino on ready callback function. We initialise a new lightSensor then add an on QNgNRi Ra g Wf gRa Re3

```
var lightSensor = new five.Sensor({
    pin: "A1",
    freq: 250
});

lightSensor.on("data", function(){
    console.log(this.value);
});
```

This piece of code is very similar to the way the temperature sensor is handled by the Johnny-Five library. First, a new sensor needs to be initialised with a few settings, then the sensor instance's on data event listener is used to wait for data to arrive.

= ReRof gUR q a NYi RefVba bS gUR YWTUg fRafbe PbQR3

```
var five = require("johnny-five");

var arduino = new five.Board();

var light = 0;

arduino.on("ready", function(){

var lightSensor = new five.Sensor({
    pin: "A1",
    freq: 250
});

lightSensor.on("data", function(){
    light = this.value;
    console.log(light);
});

});
```

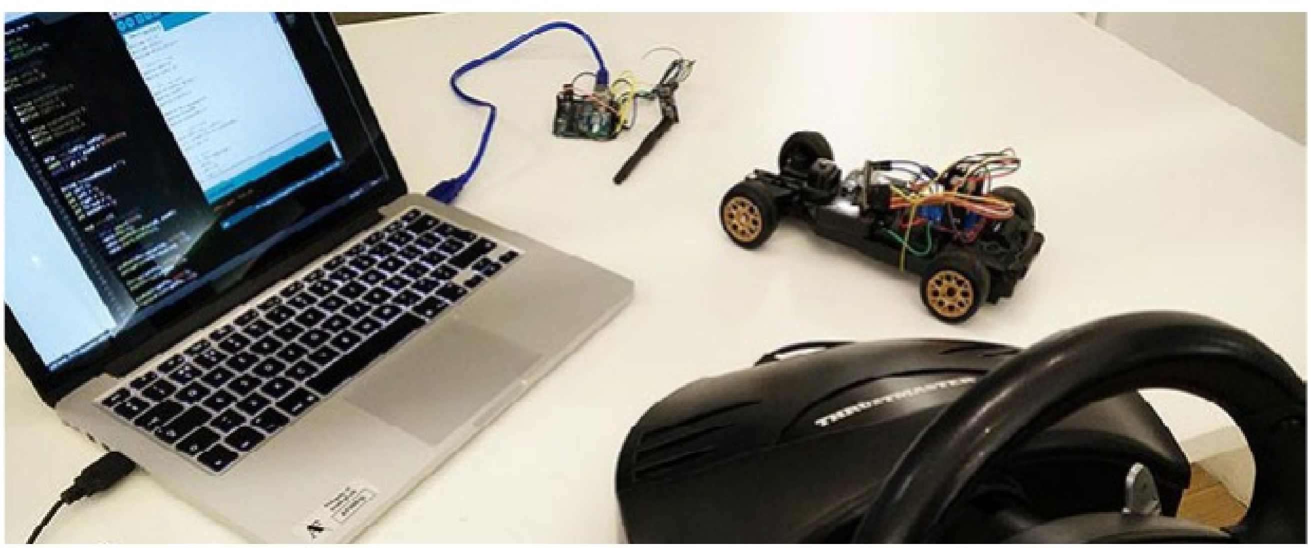
HNiVaT gUVf Vagb NaRj YVTUg+Wf q YR NaQ RagReVaT node light.js into the command line will result in light sensor readings appearing every quarter of a second. the `freq` (frequency) property is where we can change this ORUNiVbej UVPU RkcRPgf N_ YYVf RPbaQi NYhR gb QRqaR gUR delay in between measurements.

Download the source code of the whole project from www.webondevices.com/download-source

WAYS FORWARD

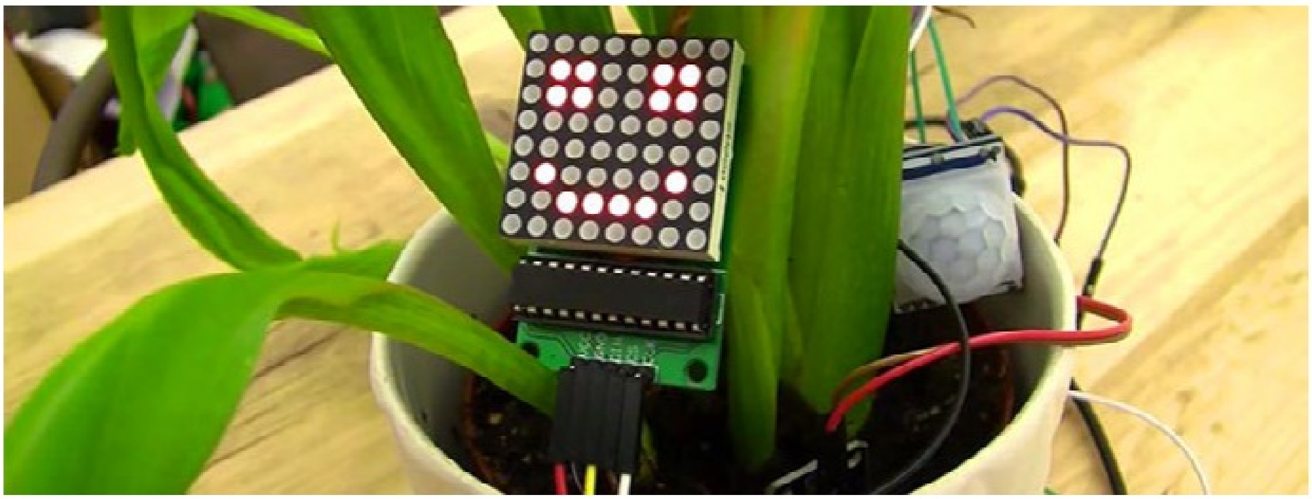
In this book you learned the basics of interfacing with the Arduino UNO using Node.js through the USB port. On Web on Devices, www.webondevices.com, you j WYq aQ f Ri ReNYc ebWRPgf OhWg hf VaT f V_ WNe _ RgUbQf +

Check out the Radio Controlled car[1] that was rebuilt from scratch using Arduinos. It connects to a computer wirelessly and with the Gamepad API allows the user to drive the car with a USB steering wheel.

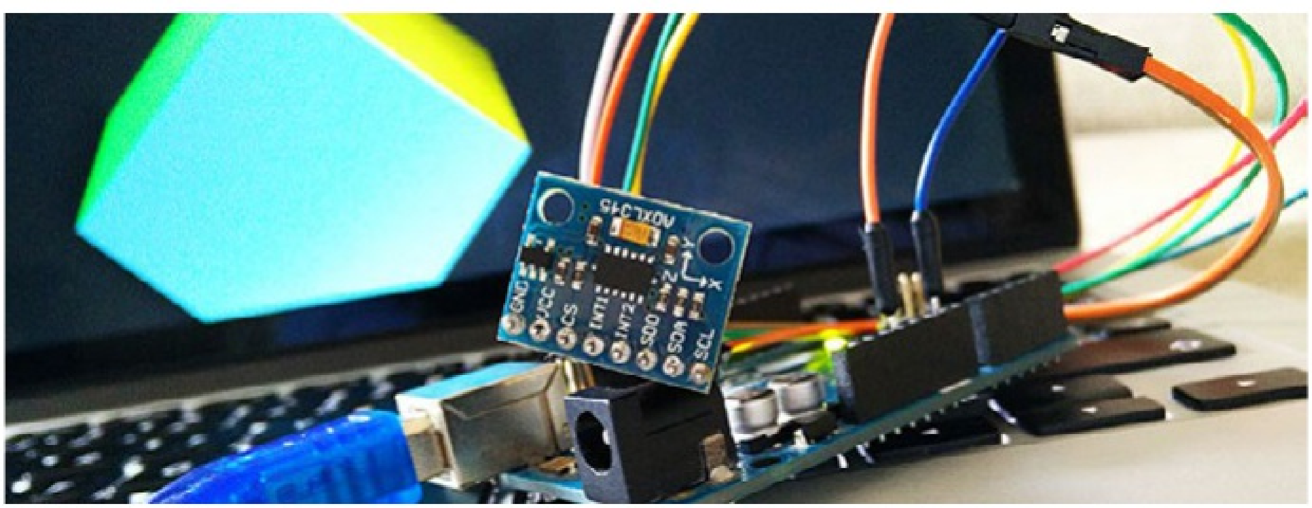


[1] : FFC- I I I I 85BA78H68E6B 4D7G AB AB78 E D6 64D7DH8A I F: : F 94 8C4

Or there's [George, the talking plant](#).[1] Through his sensors he can detect temperature, light, motion and soil moisture. He complains when he is not happy with any of the sensor readings, and can also answer basic questions. He talks and listens using the WebSpeech API.



There's also an [Arduino gyroscope project](#)[2] that lets you rotate 3D CSS objects on screen using a physical controller.



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[1] : FFC- I I I I 85BA78H68E6B F: 8 4D7G AB C 4AF I F: 4H4E6DCFHB68 D86B9A F

[2] http://www.webondevices.com/rotate-a-css-3d-cube-with-an-arduino/

Using Node.js to communicate with the Arduino is just one of many ways to use JavaScript for building electronic projects. In these examples, the JavaScript code was running on your computer processor, and we've been sending commands to the Arduino. Other boards like the Raspberry PI, Arduino Yún, Tessel, and the Espruino can actually execute JavaScript on their own. The Arduino compatible Particle boards expose a RESTful API, and there's a Node.js library to work with them too. Particle boards connect to the internet wirelessly, so the Node library doesn't have to rely on a USB connection.

The Web on Devices project is dedicated to keep pushing the limits of what's possible with development boards and smart devices leveraging mainly web technologies. In the upcoming projects we will explore all the mentioned boards and techniques.

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