IOT on the cheap!

https://tinyurl.com/bcciot

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Meet John

“meet John. John is a forgetful fellow...
One day, John drove off to work <”door” goes up, car drives out of driveway...>
He got to work and remembered something ... he just can’t remember what.
Whipping out his handy-dandy smartphone app, he checks his home dashboard.

<open Blynk>

Oh no! The garage door is standing OPEN! John quickly calls the neighbor, who graciously nips next door and closes it. Unfortunately, the neighbor leaves the light on in the process.

John smiles happily as he sees that the door is now closed.
But wait that ... the garage light is still on.
A quick flick of the switch and ... voila!

John happily returns to work. However, fate is not yet done with our hero ...
<SPLOOSH!>
Suddenly, the awful happens! A pipe splits in his basement, and it starts spraying everywhere!
Fortunately, this isn’t the first time the 1961-era-pipes have given him trouble. The last time, he came home to 6” of water in the basement. Never again, he vowed.
Just in case, he put this handy-dandy moisture sensor in the corner. As soon as water started going ...
<add water to the basement>

His phone beeps at John. GAH! What is it this time, he wonders. Yikes!! He races to his car and arrives in time to avert major catastrophe.

After cleaning up, John wants to make sure things dry out. To make sure his fans ‘n such are actually working, he sticks a humidity sensor nearby. Sure enough, over the next few days he sees the moisture level going down.

What we'll cover:

- What is IOT
- hardware
- software
- general "what kind of stuff can we do"

IOT??

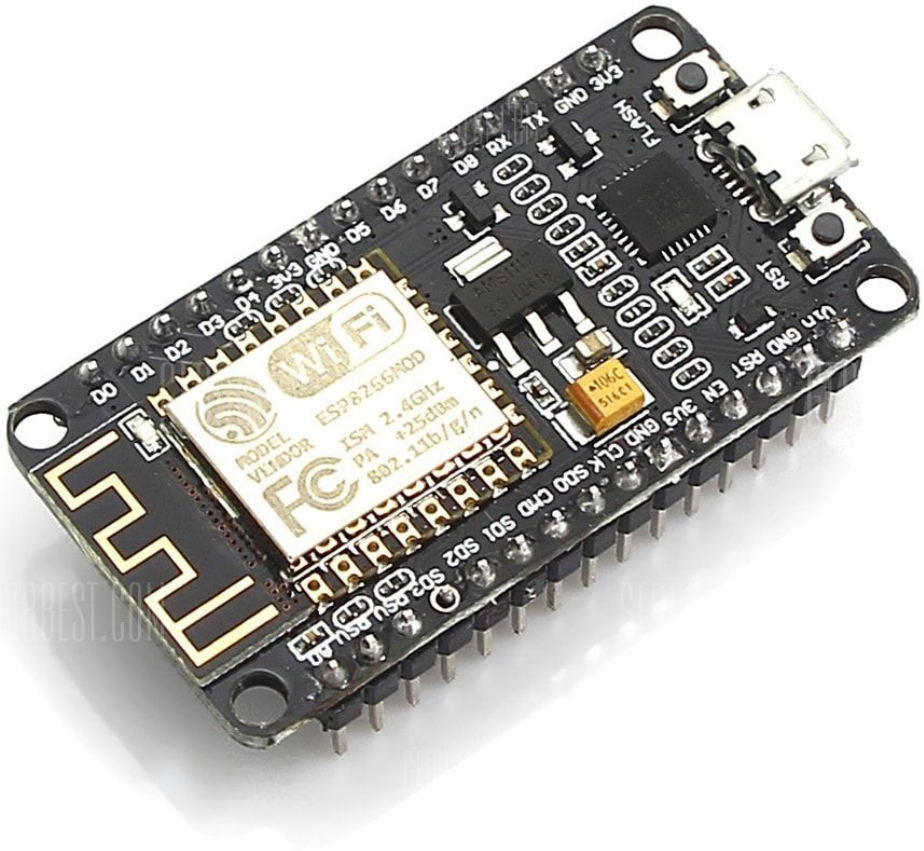
Definition is fuzzy, but often *small*, *internet-connected* ... things. Some that you might think “hey, that’s a GREAT thing to make accessible! ... and other things you wouldn’t.

Often, its devices using:

- Sensors (temp, humidity, sunshine, moisture, motion, electricity usage)
- Switches/control (nest thermometer, lights, locks, doors)

Usually standalone functionality (connects to internet/cloud by itself)
...but doesn’t have to be (intermediate home automation gateway)

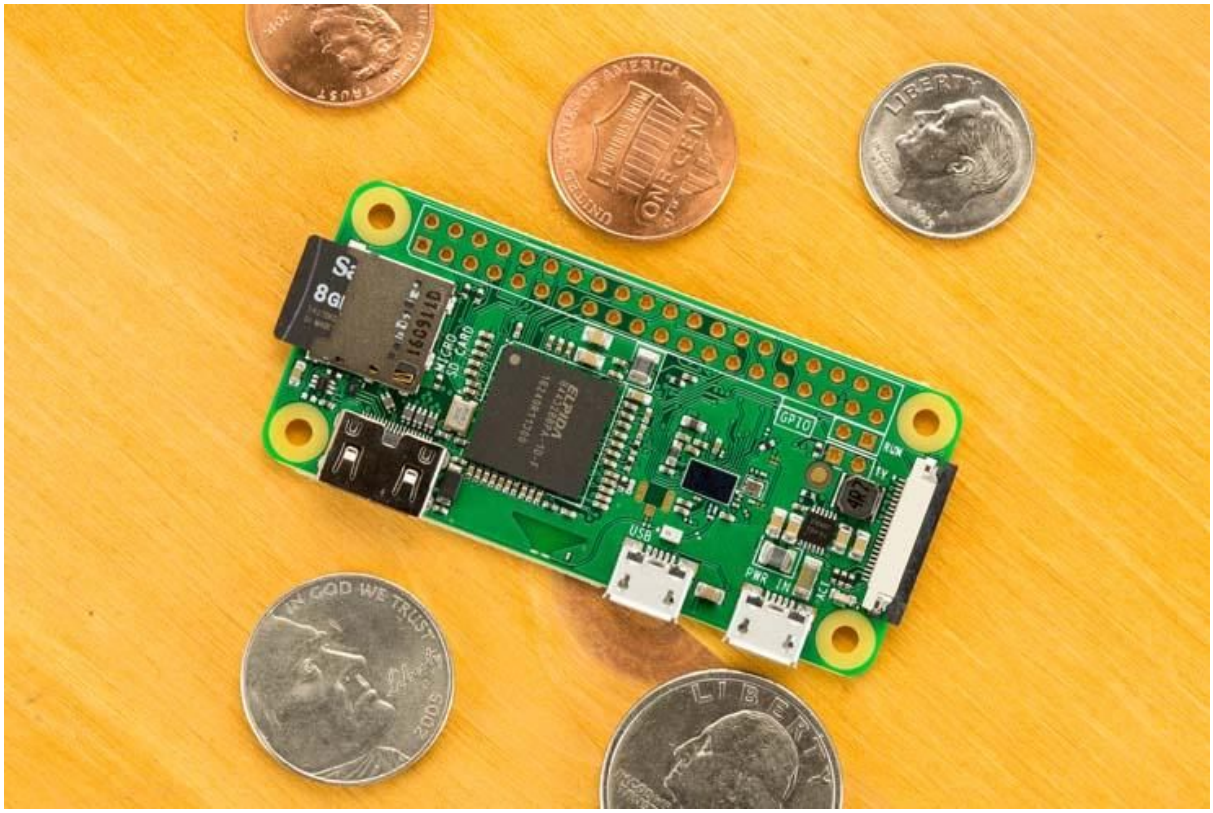
So you’ve got this wild idea to connect your sock drawer to the internet ...



ESP8266. Super cheap, programmed via Arduino IDE.

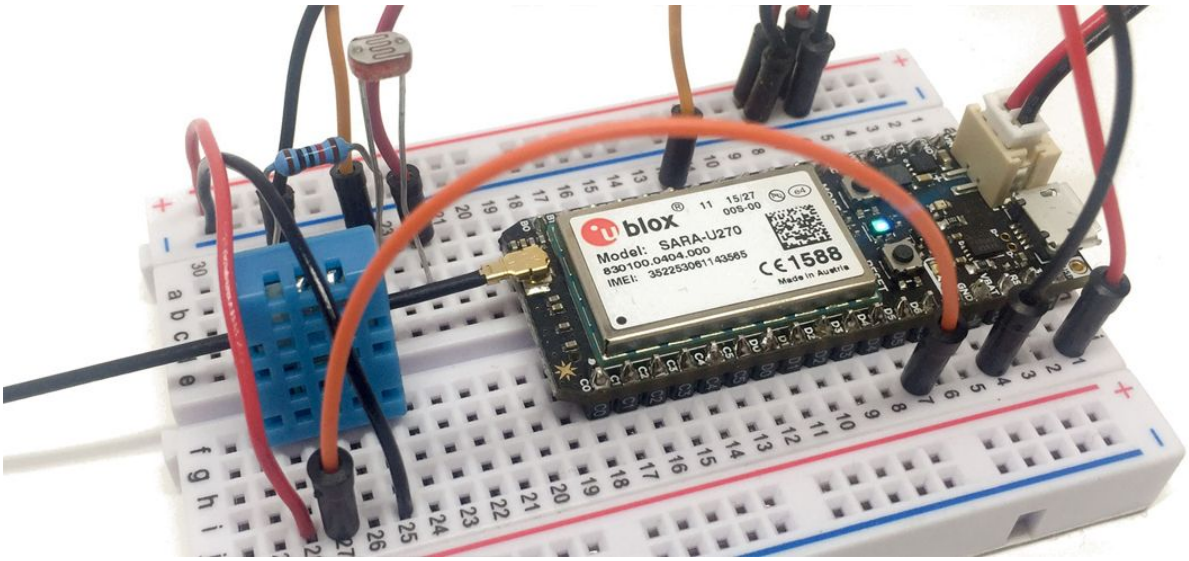
built in wifi
powered by 3.3v or the handy USB connection

1. generic nodemcu board
    a. approx $8 on amazon (https://goo.gl/rC77R7)
    b. $4.30 overseas (I used this one: - https://goo.gl/ld56u2)
2. adafruit feather
    a. $17 :https://www.adafruit.com/products/2821
3. sparkfun thing
    a. $16 : https://www.sparkfun.com/products/13711
4. linknode r4
    a. $10 : https://www.amazon.com/gp/product/B01FVJ8XSU/
    b. control high power ac/dc devices!



Raspberry Pi Zero W - now with built-in wifi! ($10)
https://www.adafruit.com/products/3400

-full linux system, solid tutorial infrastructure
-available in starter pack bundles for ~$24



https://openhomeautomation.net/monitor-data-anywhere-using-particle-electron

Particle Electron $49 : cellular (2g) board ... but $2.99/month 2g cell access (up to 3mb)

hobbyist level! (great for remote sensors)

What kinds of stuff can we do?

Data collection -> temperature, humidity
Alerting -> motion alarms, water in basement
Checking -> did I remember to close the garage door?
Controlling -> close the garage door, turn lights on and off

- *How long did the kid brush their teeth?*
- *Are all the chickens in the coop?*
- *When was the last time I opened my sock drawer?*

Talk the talk (protocols used)

- Http + REST
- Mqtt protocol (https://en.wikipedia.org/wiki/MQTT)
    - maintains a connection/allows for push notification
    - requires a broker (some machine in the cloud “in between”)
    - specifically for “small footprint” solutions (read: limited RAM and processing power)
- Custom (blynk.cc)

Implicit: iot is for *small* stuff! We’re *not* throwing objects or complex data types back and forth ... we’re sending alerts, sensor values, signals to turn things on or off.

(something of an arbitrary designation/distinction)

Free (or free to start) services

Blynk.cc

http://blynk.cc
android/ios app with alerting
Protocol: custom
(https://github.com/blynkkk/blynk-server/blob/master/docs/README_FOR_APP_DEVS.md#protocol-messages)
Easiest of all the ones I tried, both the libraries and the ios app are very slick!
Server app is open source, so you could host your own if you're so inclined...

Pushover.net

http://pushover.net
android/ios app
Protocol: http
-commercial/high volume option

Adafruit.io (beta)

https://io.adafruit.com
Protocol: mqtt
Ios and android If-this-then-that app integration (http://ifttt.com)
(ifttt alerting was spotty, in my experience)
Web accessible dashboards
can export data

Getting set up...

Install arduino [latest version]
https://www.arduino.cc/en/Main/Software

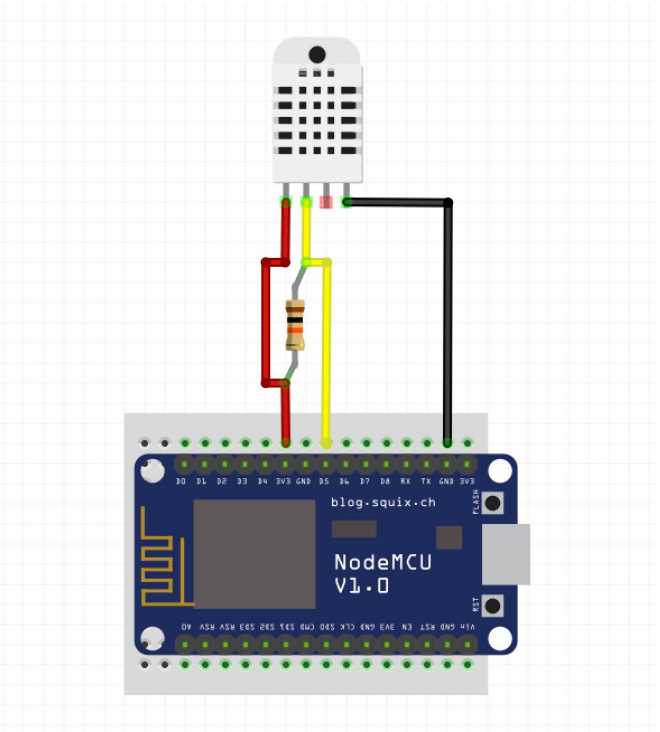
Install arduino esp8266 extensions
https://learn.adafruit.com/adafruit-huzzah-esp8266-breakout/using-arduino-ide
<walk through ^^, first setting preferences, then going to board mgr & installing esp8266 extensions)

Help with hardware

Breadboards: https://learn.adafruit.com/breadboards-for-beginners/introduction
Getting started with arduino https://learn.adafruit.com/lesson-0-getting-started/breadboard
Soldering for beginners: https://www.youtube.com/watch?v=Qps9woUGkvI

Data logging example using adafruit.io

Hardware notes:



Set up adafruit account

https://learn.adafruit.com/adafruit-io/overview
https://adafruit.io

Set up the things we're going to track...
New feed (feed == variable that's sent/received)
->temperature
->humidity

Groups => Feeds can be members of multiple groups
Dashboards => seeing what feeds are doing.

Set up arduino code

Install adafruit mqtt client library
Sketch=>Include Library=>Manage Libraries
search for "Adafruit mqtt" and install

Example base: Arduino ide => Examples => Adafruit MQTT Library => mqtt_esp8266

Add feeds for temperature and humidity ...

```
// Setup feeds called 'temp_in_c' and 'humidity' for publishing.
// Notice MQTT paths for AIO follow the form: <username>/feeds/<feedname>
Adafruit_MQTT_Publish temperature = Adafruit_MQTT_Publish(&mqtt, AIO_USERNAME "/feeds/temp_in_c");
Adafruit_MQTT_Publish humidity = Adafruit_MQTT_Publish(&mqtt, AIO_USERNAME "/feeds/humidity");
```

In the body, add code to get temperature and humidity values...and then publish

```
<reference methods in code>
```

Notes:
MQTT does try and maintain a connection
Boilerplate code will see if cxn exists, if not it'll reconnect automatically

Upload to the 'duino ...

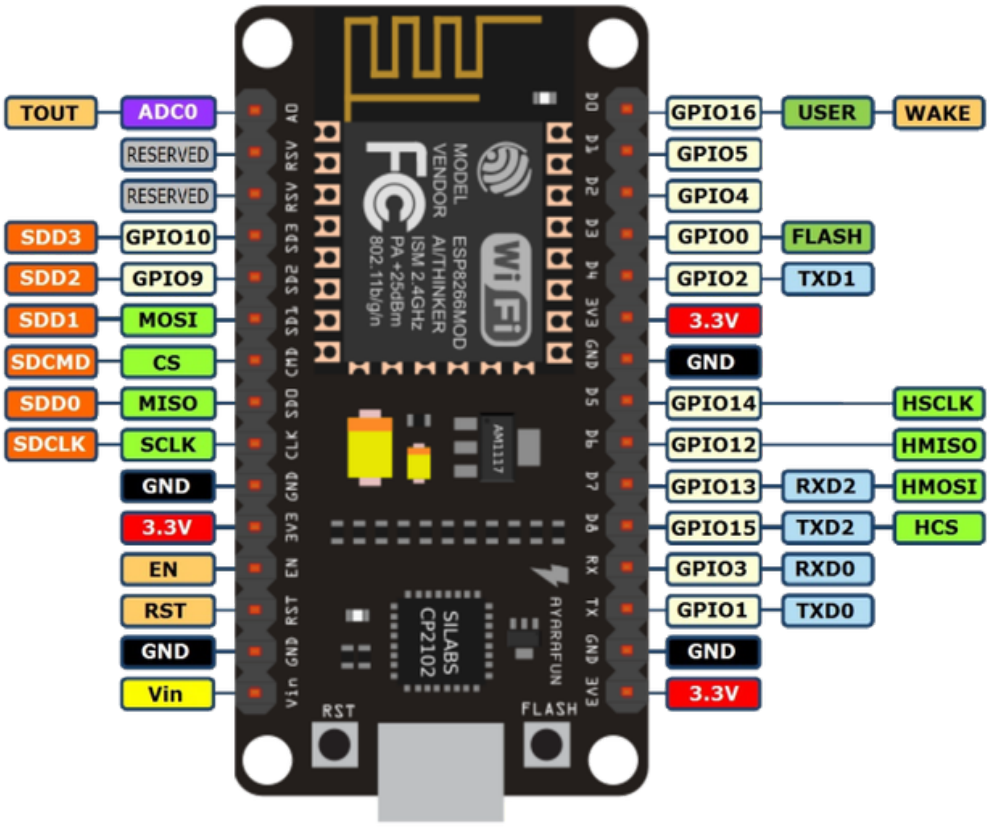
Back to dashboard ...
Watch graphs ....
Breathe hot 'n heavy (on the *sensor*)

Mobileish view

Data download-able in feed view

Hardware note:

NodeMCU “D” pins don’t correspond to the arduino pins, so you’ll need to do some translation. On this pic, match the D1,D2 etc to the corresponding GPIO label. So D1 is GPIO05 which is arduino pin 5. D5 is GPIO14, so arduino pin 14. Try to stick with using D1-D8, as otherwise there’s some odd behavior that can occur.



Obligatory blynk'ing led ...

no arduino demo is complete without a blinking led ...

Install Blynk ios app

Install blynk library (https://github.com/blynkkk/blynk-library)

Blynk IOS app => create account
Blynk IOS app => create new project
Blynk IOS app => set device type to nodeMCU

Now....this is going to be a bit involved, so bear with me.

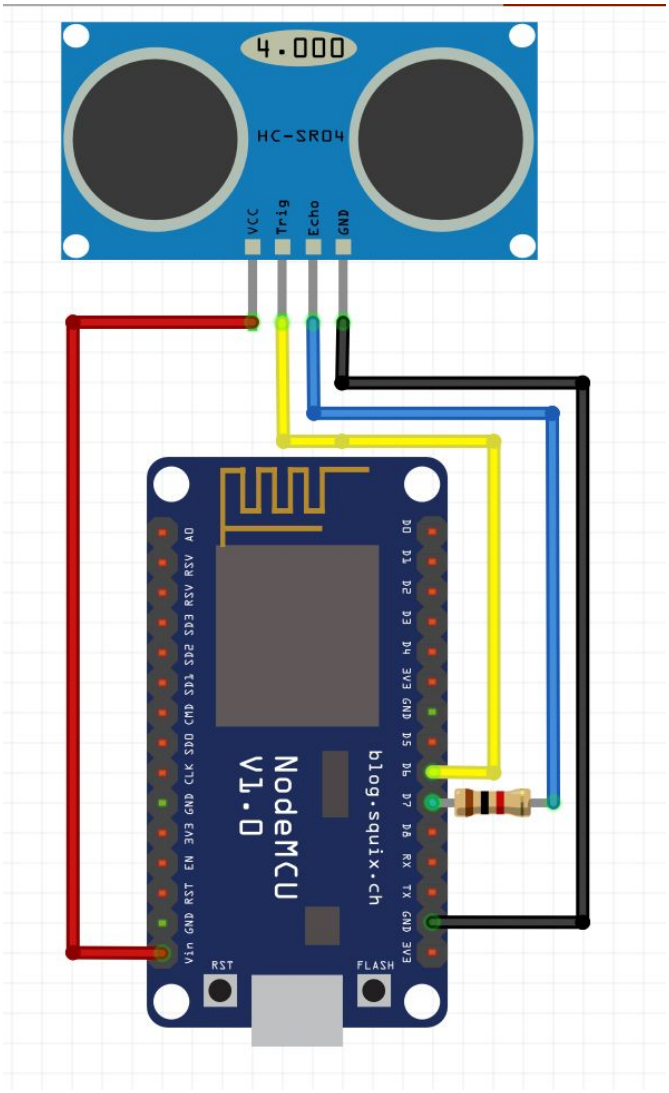
1.) Add button, name, set to digital, D4
2.) Arduino IDE Load Blynk => boards => esp8266 example
3.) Load sketch
4.) Run ios app

Ta-da!

Ever wonder if you left the garage door open?

Hardware notes:

the HC-SR04 ultrasonic sensor will work with a 3.3v input (trigger pin), but needs 5v to it's vcc pin (use the "vin" pin on nodemcu board). The echo pin will return a 5v signal, but the esp8266 is 5v tolerant on it's inputs.



<add lcd widget to blynk app>

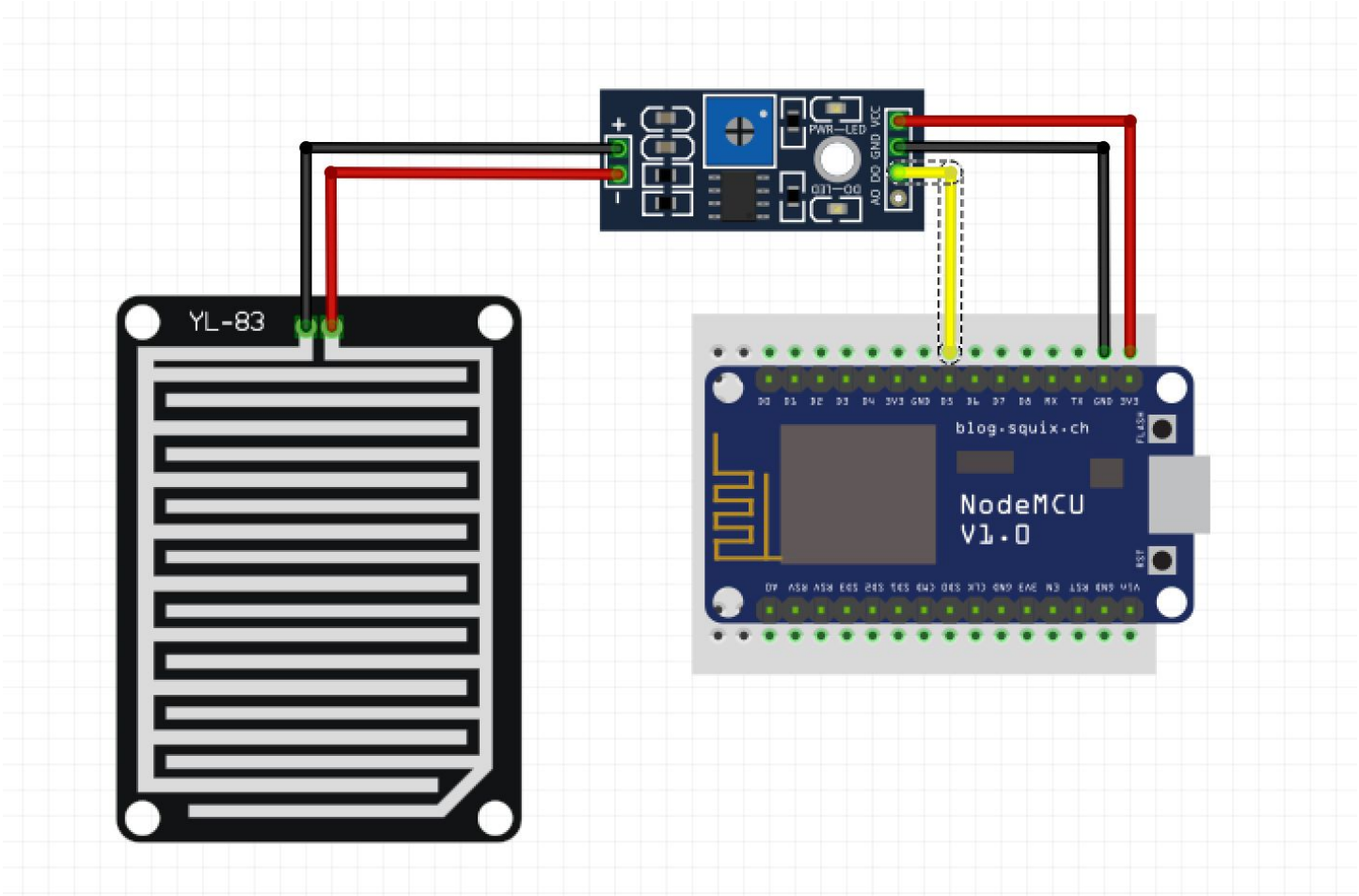
Bcc2016.blynk.garagedoor

Ios app => add LCD widget
code => add <ultrasonic cruft>

Danger, Danger will robinson! (keeping tabs on emergencies)

Hardware notes:

This sensor has two kinds of output. 1) “Is there rain? Y/N” and 2) “how wet am I?” We want to know #1, so we use the digital connection. If we wanted to know how wet it was (10 drops? 30? 2?) we’d use the analog connection.



Basement leakage == bad ...

Bcc2016.blynk.watersensor

ios app => add led
Sprinkle water ... led goes on!

Ok, that’s nice ... but it doesn’t help a lot if we don’t *know* it happened

ios app => add notification widget
arduino code=> add notify message

Start the blynkapp
Start app ... switch to background ....

Note ... if you've left the app/sketch "on" ...and the blynk app wasn't force-quit ... it stays running even if the phone gets turned off/back on

If time allows ... demo OTA or blynk temp app

SECURITY::

Why care?

https://www.tripwire.com/state-of-security/security-data-protection/cyber-security/5-significant-ddos-attacks-2016/

- krebs on security DDOS (2x the biggest attack ever seen)
- dyn dns ddos (100,000 enslaved iot devices) that took down a good part of the internet

For YOU, the hobbyist, not likely to be an issue like that. BUT ...
https://www.dailydot.com/debug/nest-security-flaw/

wep2 or greater for wifi
https for broker/server connectivity (blynk has https option)
password/key secured! (small and large scale provide this)

Don't just think smart ... think sneaky, underhanded, and malicious

What kinds of nefarious things could someone do if they hacked your hobbyist iot access...?

lights: in the dark, no one can hear you curse
Internet enabled garage door sensor ... could be monitored for arrival/leaving
Thermostat ... *big* energy bills when away from home ... or just seeing when folks are gone (note: nest has already had this happen.. https://www.dailydot.com/debug/nest-security-flaw/)
Paired with motion sensors ... who is home?
paired with garage door opener ... (oops)
paired with chicken coop temperature sensor ... ok, this one's probably pretty safe.

Sensors used in the demo:

HC-SR04 ultrasonic (distance) sensor ($2-$5)

Amazon: https://goo.gl/Ffjgx3

hc-sr04 arduino library: https://github.com/hemalchevli/ultrasonic-library

Water Sensors ($7ish)

Amazon: https://goo.gl/aDMEBo

Temperature/Humidity Sensor (DHT22 - $10)

https://www.adafruit.com/products/385