

IOT on the cheap!

<https://tinyurl.com/bcc2016iot>

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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! Forget the light, the garage door is standing OPEN! John quickly calls the neighbor, who graciously nips next door and closes it. Unfortunately, he 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 ... voilia!

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>

GAH! What is it this time, John 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”

What is IOT

Definition is fuzzy, but often *small*, *internet-connected* ... things. (that you wouldn't necessarily think of as internet-connected)

Devices using:

- Sensors (temp, humidity, sunshine, moisture, motion, electricity usage)
- Switches/control (nest, 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 ...

A few chip options:

Esp8266 (\$3-15)

super cheap, programmed via Arduino IDE

1. adafruit huzzah (what I used in this presentation)
 - a. \$10 : <https://www.adafruit.com/products/2471>
 - b. built in power, can take 12v and step it down to 3.3v
 - c. tutorial: <https://learn.adafruit.com/adafruit-huzzah-esp8266-breakout/overview>
2. sparkfun thing
 - a. \$16 : <https://www.sparkfun.com/products/13231>
3. ESP-01 (with 2 gpio)
 - a. \$7: <http://www.amazon.com/Esp8266-Esp-01-Serial-Wireless-Transceiver/dp/B012YW5BE6>
 - b. \$3.10 <http://www.electrodragon.com/product/esp8266-wi07c-wifi-module/>
 - c. requires 3.3v to be provided

Raspberry Pi Zero (\$5 + ethernet)

-full linux system, solid tutorial infrastructure

CHIP (\$9)

<https://www.kickstarter.com/projects/1598272670/chip-the-worlds-first-9-computer>

- onboard wifi, bluetooth
- debian linux

Photon (\$20-\$70)

<https://www.particle.io/>

\$19 : wifi board

\$69 : cellular (3g) board

Sensors used in the demo:

HC-SR04 ultrasonic (distance) sensor

Amazon:

<http://www.amazon.com/RobotLinking-Ultrasonic-Distance-Mega2560-Duemilanove/dp/B016OMSXYW>

Ebay:

http://www.ebay.com/sch/i.html?_from=R40&_trksid=p2050601.m570.l1313.TR8.TRC2.A0.H0.XHC-SR04.TRS0&_nkw=HC-SR04&_sacat=0

Water Sensors

<http://www.amazon.com/Sensor-Rainwater-Module-Detection-3-3V-5V/dp/B00GN7O7JE>

http://www.ebay.com/sch/i.html?_from=R40&_sacat=0&_nkw=water+sensor+arduino&rt=nc&LH_BIN=1

Temperature/Humidity Sensor (DHT22)

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

<http://www.amazon.com/SMAKN%C2%AE-Digital-Temperature-Humidity-Measurement/dp/B00MIBRFTI/>

http://www.ebay.com/sch/i.html?_from=R40&_sacat=0&_nkw=dht22&rt=nc&LH_BIN=1

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

in combination

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

Talk the talk (protocols used)

- Http + REST
- <TODO, insert MQTT picture>
- 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)

<http://adafruit.io>

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

Dioty.io

<http://dioty.appstor.io/>

ios/android app

Protocol: mqtt

good tutorials, app straightforward and good for learning

Larger scales:

Amazon aws IOT

Microsoft azure IOT

IBM (?!!)

Getting set up...

Install arduino 1.6.6+

<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>

Data logging example using adafruit.io

Create adafruit account & sign up for adafruit.io beta

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

<land on dashboard page>

Set up the things we're going to track...

New feed => think of this as the "variable" that'll be sent or received.

->temperature

->humidity

Groups => "groups" of feeds. Feeds can be members of multiple groups

Dashboards => seeing what feeds are doing.

Now, on to the code!

Install adafruit mqtt client library

<https://learn.adafruit.com/adafruit-io/arduino>

Arduino ide => Examples => Adafruit MQTT Library => mqtt_esp8266

or preload: bcc2016.adafruit.io.temperature.ino

Header bits for DHT22 sensor ...

Add feeds for temperature and humidity ...

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

const char HUMIDITY_FEED[] PROGMEM = AIO_USERNAME "/feeds/humidity";
Adafruit_MQTT_Publish humidity = Adafruit_MQTT_Publish(&mqtt, HUMIDITY_FEED);
```

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

```
float humid = dht.readHumidity();
// Read temperature as Celsius (the default)
float temp_c = dht.readTemperature();
// Read temperature as Fahrenheit (isFahrenheit = true)
float temp_f = dht.readTemperature(true);

// Check if any reads failed and exit early (to try again).
if (isnan(h) || isnan(t) || isnan(f)) {
  Serial.println("Failed to read from DHT sensor!");
  return;
}

//publish the temperature
if (! temperature.publish(temp_f)) {
```

```
    Serial.println(F("temp publish failed"));
} else {
    Serial.println(F("OK!"));
}

//publish the humidity
if (! humidity.publish(humid)) {
    Serial.println(F("humidity publish failed"));
} else {
    Serial.println(F("OK!"));
}
```

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 ...

(odd reset-button-dance)

Back to dashboard ...

Watch graphs

Breathe hot 'n heavy (on the *sensor*)

Mobileish view

You can *technically* edit in the mobile view ... but it's very buggy

Data download-able in feed view

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

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

- 1.) Add button, name, set to digital, GPIO0
- 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?

<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)

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

SECURITY::

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 with 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

Paired with motion sensors ... who is home?

paired with garage door opener ... don't even go there

paired with chicken coop temperature sensor ... roast chicken anyone?