An IoTa of IOT

SIGCSE 2017

Intros!

Us

Bill Siever,   Michael Rogers, Sandip Subedi
Washington Univ.   Northwest Missouri State

You!

Agenda

Overview

   What, Why, Why Now, and Why in EDU?

Curricular Considerations

   Topics, Platforms, & You

   Sample Courses

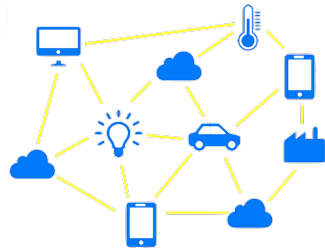Hands-on: Fun with Things

Discussion

What is IoT?

A network (**internet**) of sensor-, actuator- and software-equipped devices (**things**) that share information among themselves as they scheme to take over the world (we may need to work on this last bit)😊

What is IoT?

Pervasive Computing and Networking of "Things"

Examples

Home: Lights, Thermostat, Smoke Alarms, Security Systems, Internet of Things Doorbell 😀
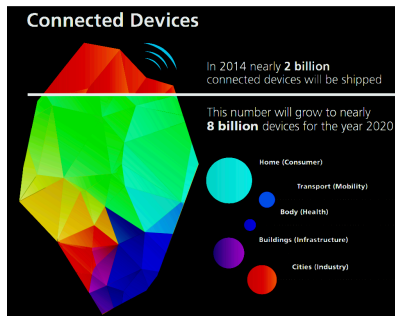

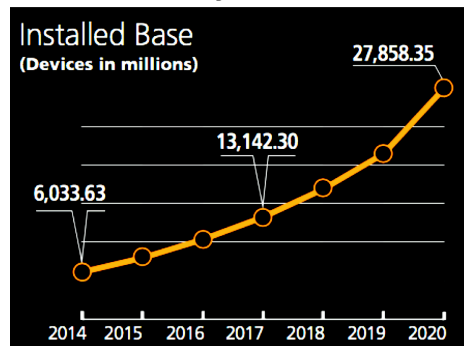In the Community: Parking Places, IoT Recycle bins, Pollution Detectors, Street Lighting,

And much, much more!

Why IoT?

Connected Devices

In 2014 nearly **2 billion** connected devices will be shipped

This number will grow to nearly **8 billion** devices for the year 2020

- Home (Consumer)
- Transport (Mobility)
- Body (Health)
- Buildings (Infrastructure)
- Cities (Industry)

Why IoT?

Installed Base
(Devices in millions)

27,858.35

13,142.30

6,033.63

2014 2015 2016 2017 2018 2019 2020

Why Now?

Not a new idea, finally successful

Moore's Law: Smaller, Faster, Cheaper

Network Coverage: Ubiquitous

Accessibility: Great GUI at your Fingertips!

Why IoT in EDU?

Provides a unique outlet for **creativity**
Students can make something ***new***.

 Fun, maker-like experience with tangible
artifacts.

Accessible multi-tier view of a complex, real-
world systems.

Curricular Considerations

When faced with the
blindingly obvious,
it's a good idea to wear
shades™. 😎

What are your objectives?

Who's your audience?

Theoretical? Applied? A hybrid?

Depth or breadth?

Faculty Considerations

Q. What do you need to know?

What we want our students to know: how to
persevere

Some electronics, or the cell number
(573.364.8890) of someone who does

A modicum of programming ability

Our Preferences

Michael's Approach: maker-wannabe: an applied, project-based course that allows students to be both creative and exercise debugging skills they never knew they had

Bill's Approach: A combination of: Hardware, Informal Software Engineering, and Informal Systems Engineering
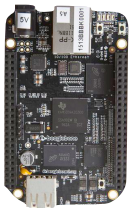
Components of an IoT Course

Things (Computers & Electronics)

Of (Programming)

Internet (Web Services, Connectivity)

Things: Plethora of Platforms

BeagleBone Black

$55; ETH;Anything

Arduino 101

$30; BLE;Wiring

Photon

$19; Wi-Fi;Wiring

Things: Plethora of Platforms

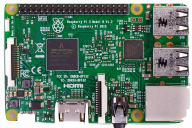| ESP8266	Simblee	Tessel 2
$<16; Wi-Fi;Wiring	$30; BLE;Wiring	$45; Wi-Fi;JavaScript

Things: Plethora of Platforms

Raspberry Pi
$16; Wi-Fi;Wiring

LightBlue Bean
$30; BLE;Wiring
No wires

Platforms

Factors (in *approximately* decreasing order of importance

Price

Support & Documentation

When faced with the blindingly obvious,
it's a good idea to wear shades.
😎

Robustness

Connectivity: WiFi? Bluetooth? Cellular?

Languages

Architecture

Of: Programming

Arduino's Wiring language (C++ and some frameworks and library tricks to make some of the awkwardness disappear) is not a standard, but it is ubiquitous

JavaScript is available on Tessel 2, and

Hands-On Interlude 1
Things Of: Blinking!
(Thanks particle.io!)

Hands-On Interlude 2
Internet: Light it up!

Internet: Bundles of Brokers / Cloud Service

Azure (Microsoft)

AWS (Amazon)

Bluemix (IBM)

Google

IFTTT.com

data.sparkfun.com

ThingSpeak

Do It Yourself

Many, Many, More

Hands-On Interlude 3
Internet: Thing's Speak

Express + Photon = ❤️

```
//talktoherokuagain.ino
void setup() {
    pinMode(D7,OUTPUT);
    Serial.begin(9600);
    Particle.subscribe("hook-response/goHeroku",
                        myHandler,MY_DEVICES);
}

void loop() {
    String temperature = String(random(1,6));
    String humidity = String(random(1,100));
    String weatherInfo = temperature + " "
                                      + humidity;
    Particle.publish("goHeroku",weatherInfo,PRIVATE);
    digitalWrite(D7,HIGH);
    delay(2500);
    digitalWrite(D7,LOW);
    delay(2500);
}

void myHandler(const char *event, const char *data) {
    // Handle the webhook response
    Serial.println("event: " + String(event));
    Serial.println("data: " + String(data));
}
```
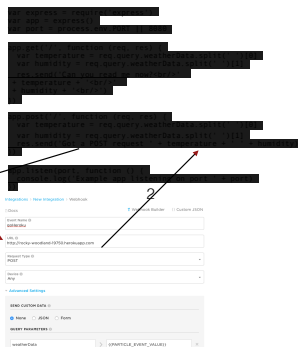
Demo: IFTTT*

*time permitting

Michael's 14 Weeks of Bliss

Week	Topics	Projects
1	Hello, IoT: An overview of the course and the IoT landscape	Identify 5 favorite projects from hackster.io; make LEDs flash in specified patterns
2	Basic Electricity and Electronics; Digital IO: LEDs and Switches	Make 3 LEDs flash in sequence or simultaneously depending on a switch
3	Analog IO; Accessing variables over the internet	Monitor temperature; publish it (in C, K or F, the choice controlled by a switch) to the internet, and display it on the IoT device
4	Invoking functions over the internet	Send Morse Code messages to an IoT device, causing an LED to flash and a buzzer to sound, from a web page
5	IFTTT	Time how long a user spends on 1 of 8 chosen activities; when the timer is paused, add the accumulated time to a Google spreadsheet
6	Other web services (e.g., ThingSpeak, Temboo)	Identify a web service of interest, and develop a project to utilize that service
7	TCP/IP and HTTP Client/Server	In teams, demonstrate a working HTTP Client/Server system
8	Midterm Projects, Lab Exam & Hackathon	–
9	Parallel v. Serial Communication I2C, SPI, UARTs; 3D printing	Create a container for your midterm project; create another 3D object using OpenSCAD. The best, as voted on by students, will be printed.
10	GPS, OLEDs and Accelerometers, Oh, My!	Display an image based on temperature (e.g., < 0 a snowy landscape; > 30, a desert); if the temperature changes too quickly, tweet yourself a warning
11	JavaScript and Node.js	Write a simple JavaScript project to simulate the rolling of 2 dices; display the results in a frequency distribution
12	Express, Heroku	Monitor a fridge, recording the number of times it is open/closed in 30-minute intervals. Results will be reported to your Heroku-based web service for retrieval via browser
13	Making PCB boards	Design a PCB board for your final project, and submit the board to 4PCB.com for printing
14	Final Projects	–

Bill's Course

Weeks	Topics	Tools & Technologies	Other
1-4	Mobile App Dev	HTML, CSS, JavaScript, PhoneGap	UI Design, User Stories, Paper Prototypes
5-9	+ Hardware, Appcessories	Arduino IDE, C++, Bluetooth Low Energy	State Machines, Sequence Diagrams, Service Oriented Architecture
10-12	+ Cloud Services	WiFi, Particle's Cloud Services	Advanced I/O (LCD, Motors), Cloud Concepts & Infrastructure
13-15	Misc. Issues, Project!	?	?

Bill's Course

Outside Class

Tools 20%
Assignments 40%
Managerial 15%
Curation 25%

Contact Time

Lecture 10%
Assessment 20%
Hands-On 70%

Questions?

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Discussion!

Resources

http://www.postscapes.com/internet-of-things-
hardware/#iot-board-comparison/view-hardware-
details3/57d333b16f2fb8ef4f28d81a/