

ACM Snippet:

Internet of Things (IoT), Basic Electronics Theory

Explanation and Project Introduction

Definition

“The *internetworking* of physical devices, vehicles (‘smart’ devices), buildings, etc., embedded with:

- Electronics,
- Software,
- Sensors, actuators, and
- Network connectivity

that enable these objects to collect and exchange data.”

(From Wikipedia)



20th cent: Energy consumption

Meter and thermostat are separate! Problems?



21st cent. Solution: Learning Thermostat

Thermostat and power meter: formerly separate, now part of a single network, saving energy.

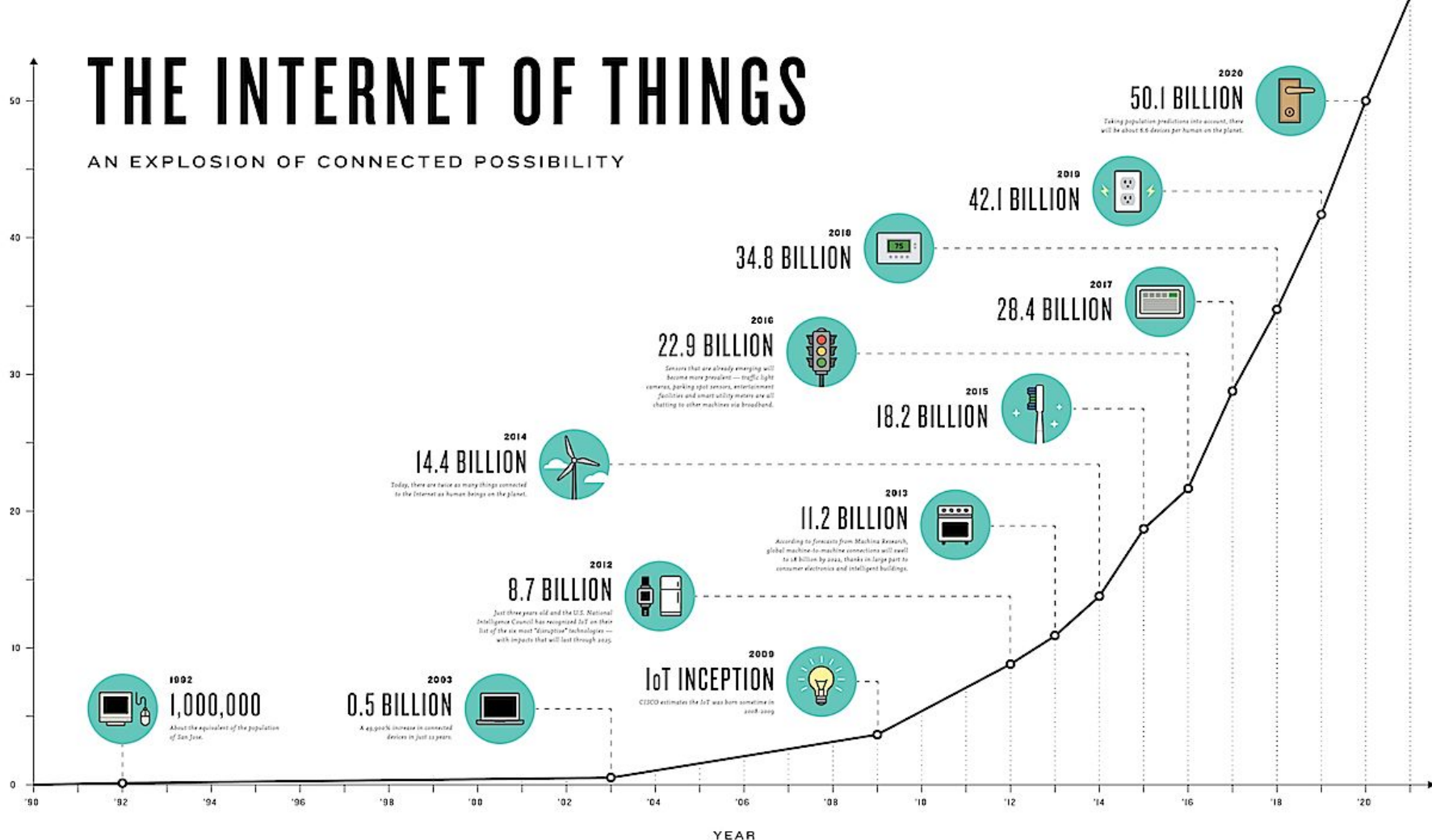
Smart device, getting smarter together through data collection and exchange.



THE INTERNET OF THINGS

AN EXPLOSION OF CONNECTED POSSIBILITY

BILLIONS OF DEVICES



Resource: shodan.io

<https://www.shodan.io/explore>

Electrical Theory

- Current
- Voltage
- Resistance
- Ohm's Law

Current (I)

- Total charge (Q) (of k electrons (e^-)) passing through some surface area per unit time (t)
- Unit: amp (A)
- $Q_{e^-} = -1.602 \times 10^{-19}$ C (1909, Millikan and Fletcher's [oil drop experiment](#))
- $1 \text{ A} = 1 \text{ C/s}$

Voltage (V)

- Difference in electrical potential energy between two points per unit of electric charge
- Could be thought of as electrical pressure (circuit = waterworks)
- Unit: volt (V, or ΔV)
- Example: 1.5V battery (AA)

Resistance (R)

- Measures the difficulty of passing an electrical current through a conductor
- Unit: ohm (Ω)
- Resistor (e.g., a 150Ω resistor) forces a voltage drop within a circuit

Ohm's Law

$$I = V / R$$

$$\Rightarrow V = IR$$

Another time...

Practical circuit example using Kirchhoff's Laws (equalities):

https://en.wikipedia.org/wiki/LED_circuit;

Applications to computer engineering (semiconductors, discrete circuits), signal processing

More theory: https://en.wikipedia.org/wiki/Mathematical_methods_in_electronics

IoT Project: Lazy Temperature Measurement (LTM)

Plant button-sized “probes”

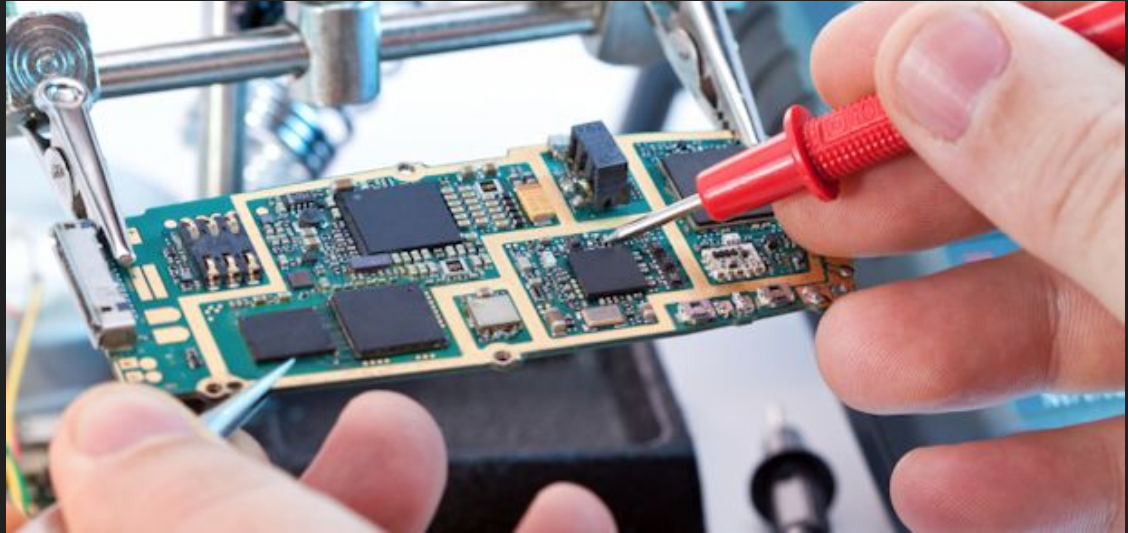
Collect temperature data, send to database

View data on web application

Project Requirements

Laundry list:

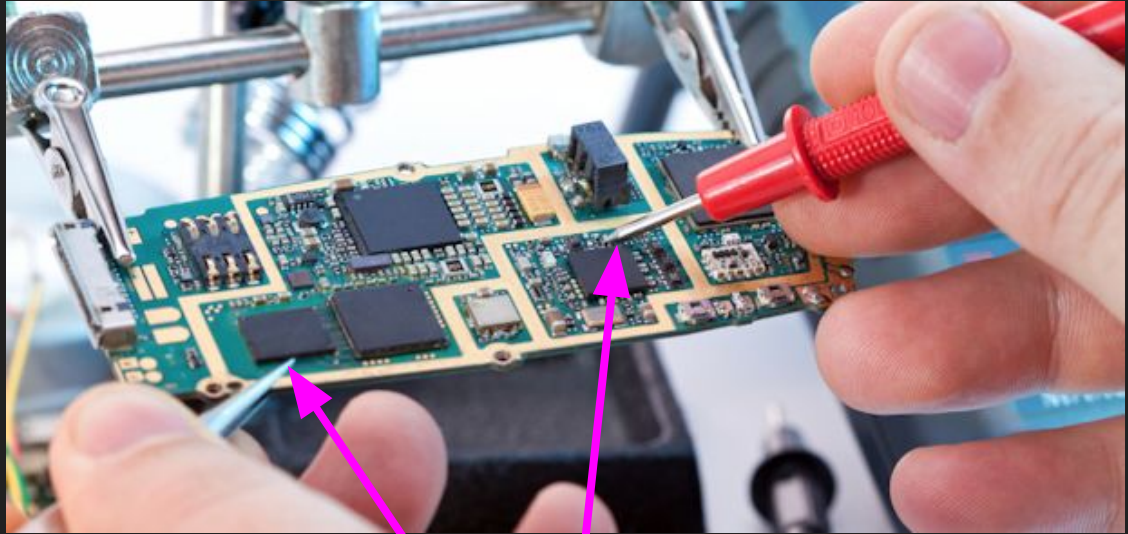
- Microcontroller (brains)
- Temperature sensor
- Networking (with master)
- Wiring, casing, power
- Web application



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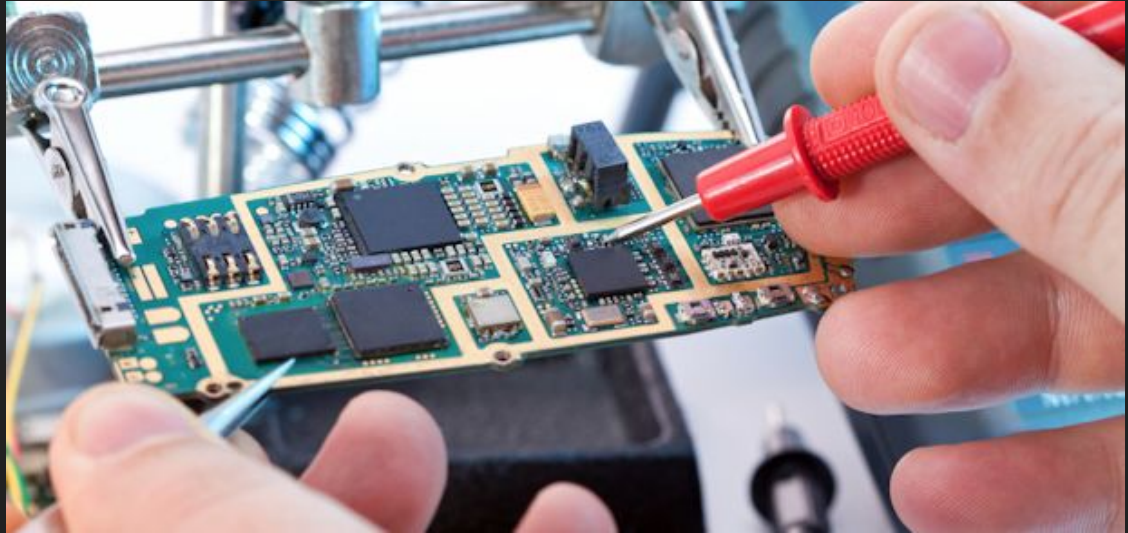


Measuring some electrical quantity (V, I, or R)
using a meter

Project Requirements, Phase 1: Construction

Laundry list:

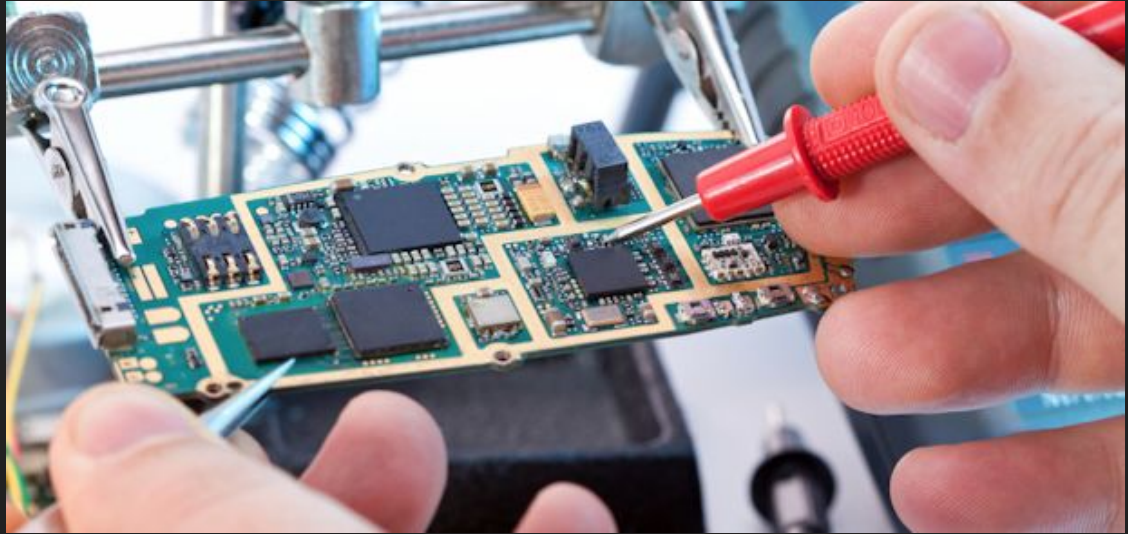
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Project Requirements, Phase 2: Production

Laundry list:

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- Temperature sensor
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- Web application



Microcontroller: Arduino

Open source

Popular among hobbyists

C-like, IDE

Smaller (coin-sized) variants available

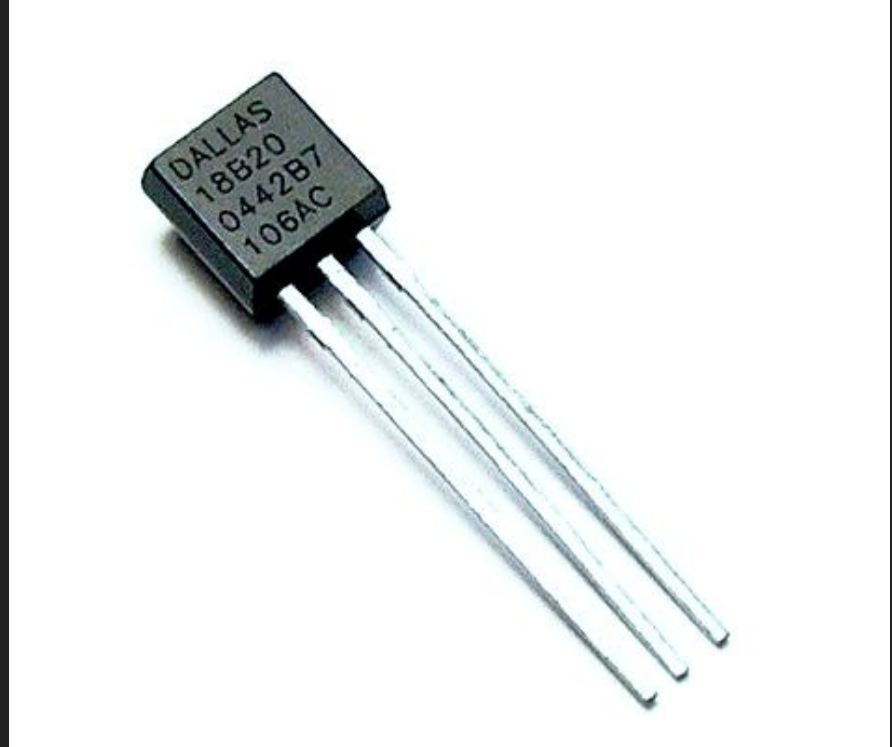


Arduino Uno

Data collection: DS18B20 temperature sensor

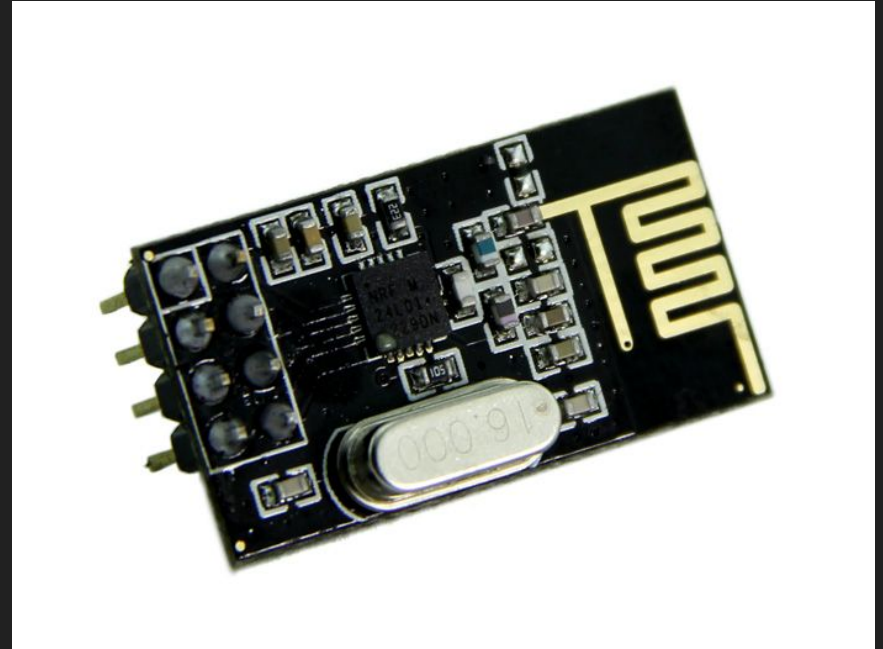
Signals temp data to controller

“Isomorphic” to...?



Networking: RF24

Broadcast information between
Arduinos



Master: Wifi-enabled Arduino

Collect temp data from slaves

Various options for this

Starting focus is on the slaves

May have each slave connect individually

