

Embedded Systems

MIOT

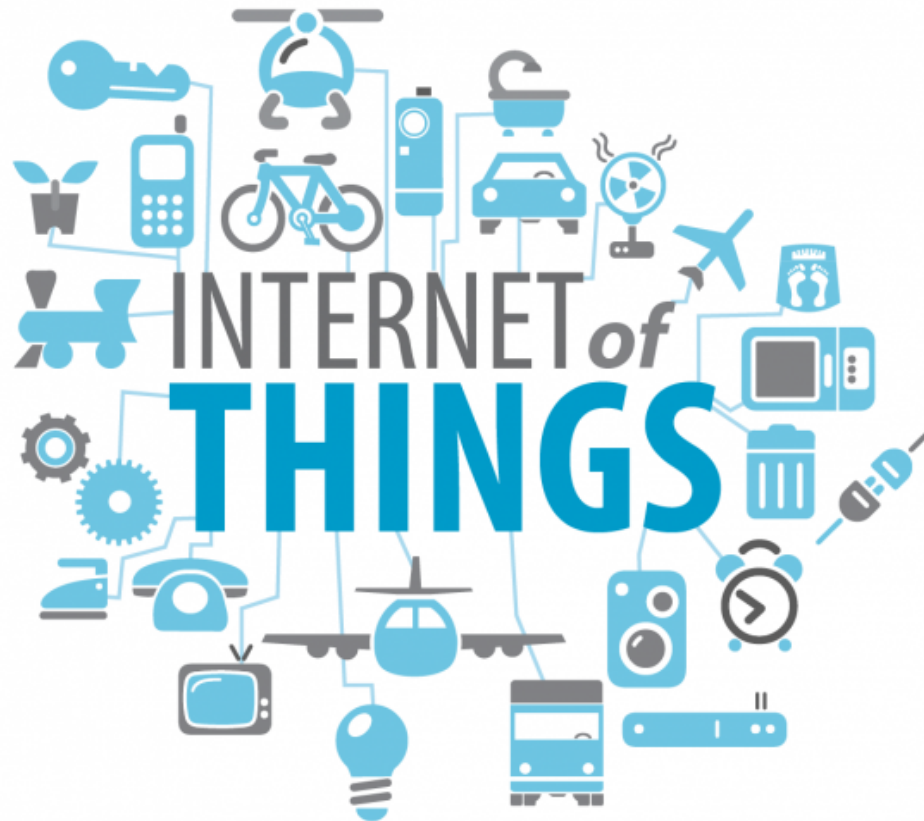
Introduction

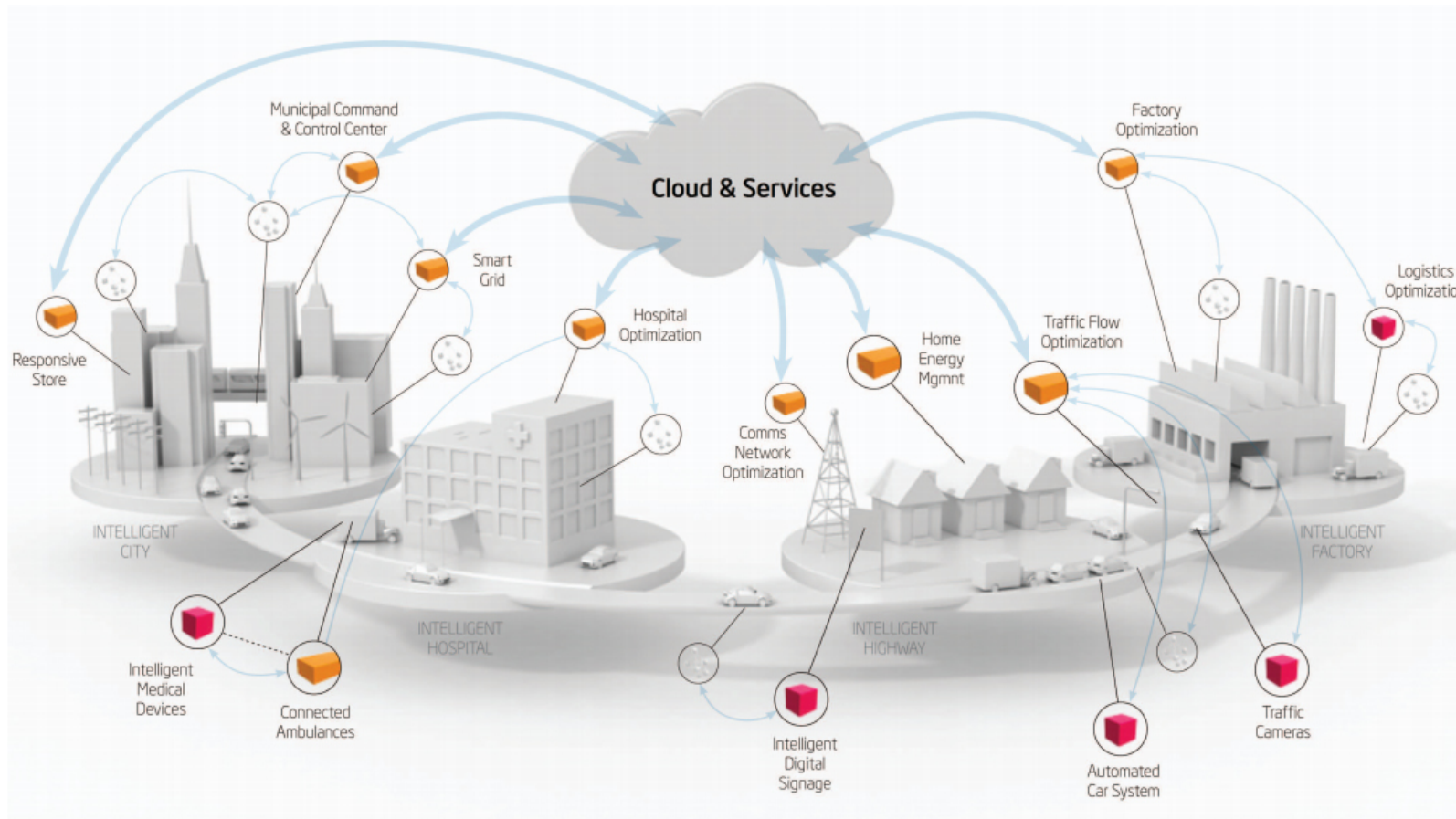
Module Delivery & Assessment

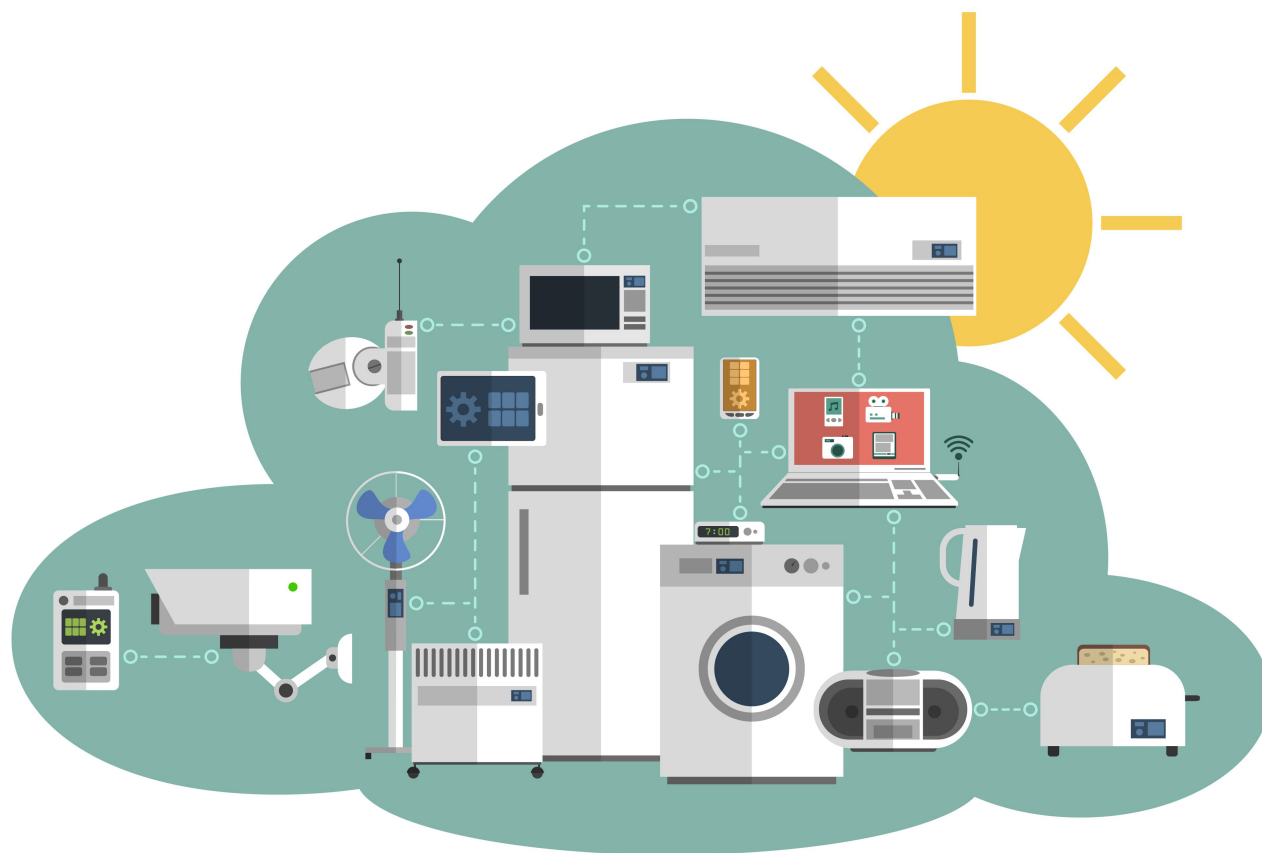
- ▶ 100% online
- ▶ 100% CA
 - ▶ Detailed CA Schedule to follow
- ▶ From Arduino to Linux, the Cloud and beyond....



What is the IoT... again...







What are "things"

- ▶ They are Embedded Systems!
- ▶ What is an Embedded System?
 - ▶ An electronic device based with a hidden small computer running one dedicated program.
 - ▶ Your microwave oven
 - ▶ Your TV remote
 - ▶ Your car key / remote locking
 - ▶ Your wifi router
 - ▶ Your TV
 - ▶ Your car fuel injection controller...



More Embedded Systems

- ▶ Aircraft flight control - hundreds of Embedded Systems
- ▶ Your car
- ▶ Comms satellite
- ▶ Curiosity Rover on mars
- ▶ Ballistic Missile fight control... “rocket man”...

IoT is nothing new....

- ▶ ... according to Embedded Systems geeks...
- ▶ Just connected Embedded Systems on steroids...

- ▶ The volume is new
- ▶ The convergence and standardisation of communication techniques is new

- ▶ Cloud backends are new
- ▶ Big-Data crunching and Deep Learning is new
- ▶ Scale of new AI is new... frightening??

Module Learning Outcomes

On successful completion of this programme the learner will be able to :

1. demonstrate mastery of basic Embedded System tools and techniques.
2. fast-prototype IoT devices, backend and client applications using Javascript based or other RAD tools.
3. design, build and test a low-power IoT wireless sensor network and supporting backend framework using specified technologies.

1. Mastery of basic Embedded System tools and techniques

- ▶ Using the AVR microcontroller on the Arduino Board to deal with Embedded basics.
- ▶ Not very powerful
- ▶ Not easy to debug
- ▶ Not very IoTish but a great learning tool.



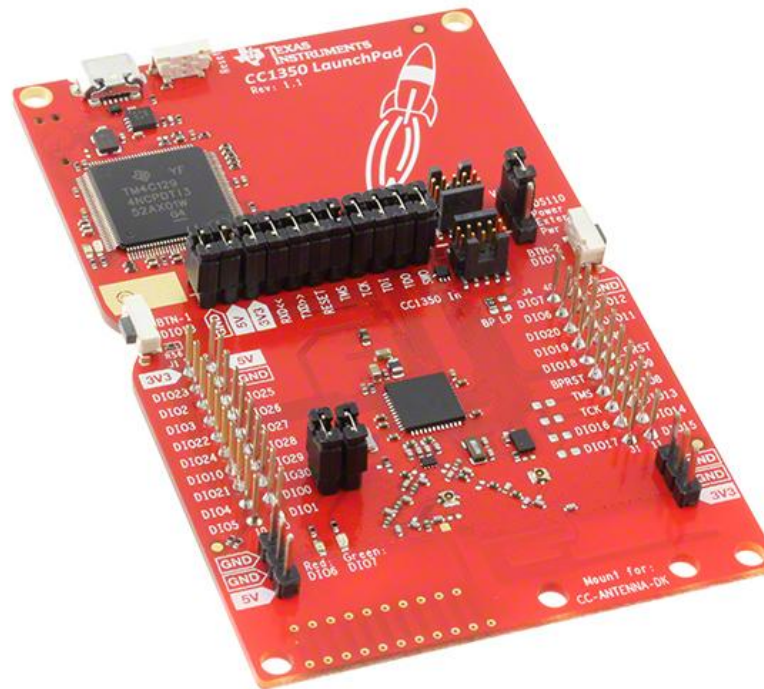
Using Arduino we can learn

- ▶ Digital I/O
- ▶ ADC
- ▶ Timers
- ▶ PWM
- ▶ LCDs
- ▶ Keypads
- ▶ Serial comms
- ▶ I2C
- ▶ SPI
- ▶ Statechart design
- ▶ Basic RTOS



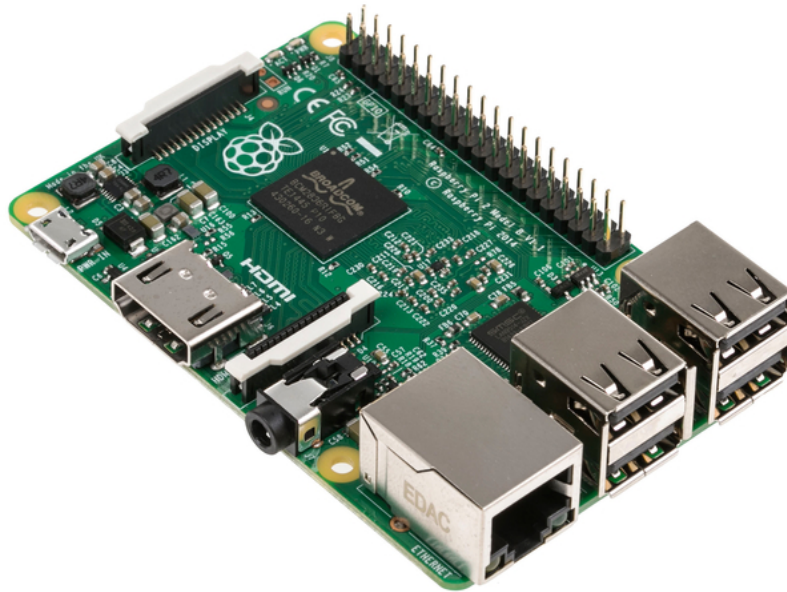
Mastery of basic Embedded System tools and techniques

- ▶ Using the TI CC1350 Launchpad board we have a sophisticated ARM Microcontroller with BLE and sub 1GHz radio interfaces
- ▶ Very IoTish!
- ▶ Very powerful
- ▶ HW debugger included



2. Fast-prototype IoT devices, backend and client applications using Javascript based or other RAD tools

- ▶ Use the Raspberry Pi
- ▶ Embedded Linux
- ▶ Can knock together prototype IoT Devices very easily with JavaScript tools



2. Fast-prototype IoT devices, backend and client applications using Javascript based or other RAD tools

- ▶ Not terribly IoTish
 - ▶ It's actually a desktop replacement computer for teaching programming in schools...
 - ▶ Lacks Embedded features...
 - ▶ Used a lot though as well supported



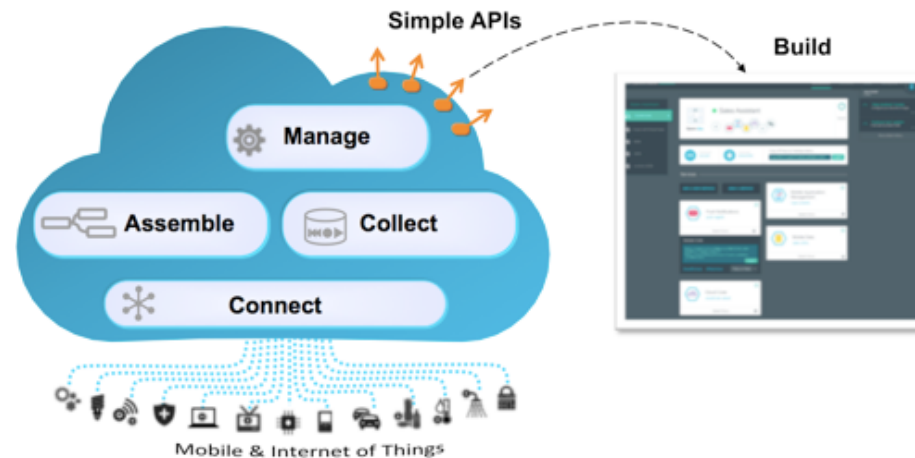
2. Fast-prototype IoT devices, backend and client applications using Javascript based or other RAD tools

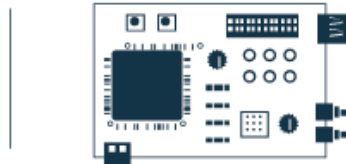
- ▶ Beaglebone Black Wireless
- ▶ Alternative to Pi
- ▶ Very IoTish
- ▶ Embedded Focused
 - ▶ Loads more pins
 - ▶ ADC
 - ▶ PWM
 - ▶ Realtime support
- ▶ Support a bit harder to get



3. Design, build and test a low-power IoT wireless sensor network and supporting backend framework using specified technologies.

- ▶ Use IBM Bluemix and Watson IoT as a cloud backend to connect our Pi and Lauanchpads to:
 - ▶ Gather data
 - ▶ Analyse
 - ▶ Control...





Your device or gateway

We start with your device, be it a sensor, a gateway or something else.
To find out how to get it connected, search our recipes.



MQTT

Your device data is sent securely up to the cloud using the open, lightweight MQTT messaging protocol.



IBM Internet of Things Foundation

This is the hub of all things IBM IoT. This is where you can setup and manage your connected devices so that your apps can access their live and historical data.



REST & Real-time APIs

Use our secure APIs to connect your apps with the data coming from your devices.

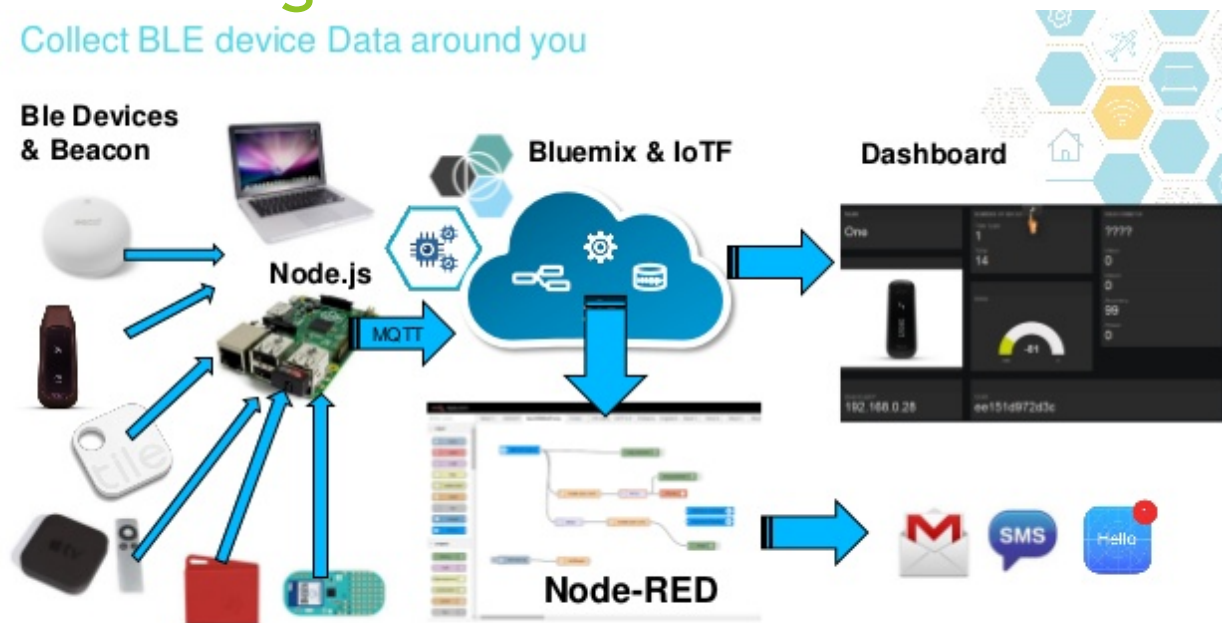


Your application and analytics

Create applications within IBM Bluemix, another cloud, or your own servers to interpret the data you now have access to!

3. Design, build and test a low-power IoT wireless sensor network and supporting backend framework using specified technologies.

Collect BLE device Data around you



12/23/2015

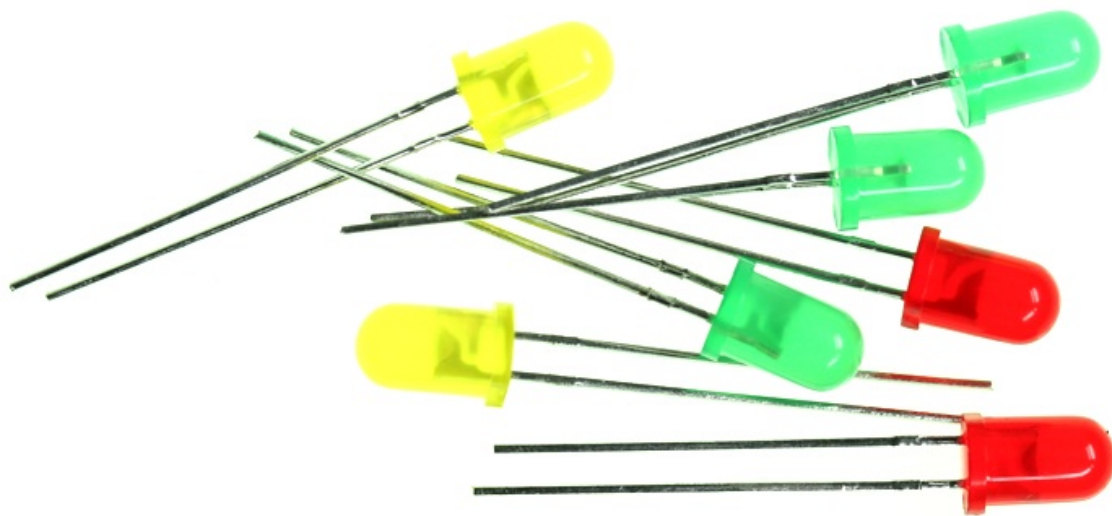
IBM Internet of Things

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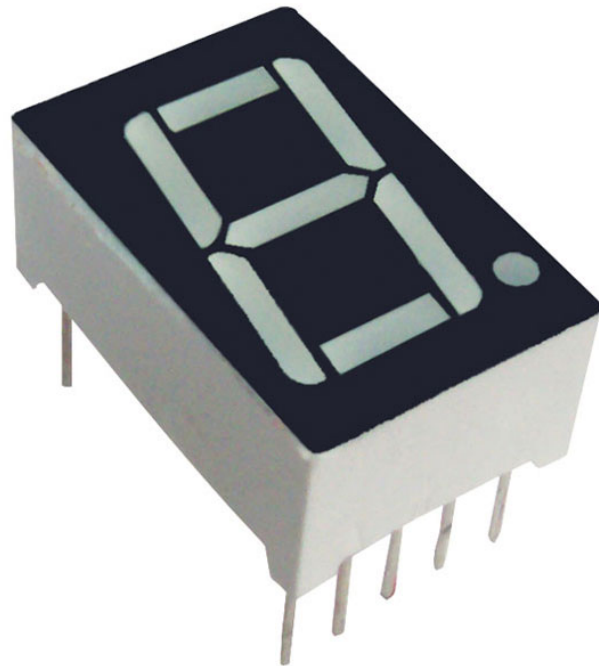
And now back down to earth...

- Some basic hardware

LEDs



7 Segment Display



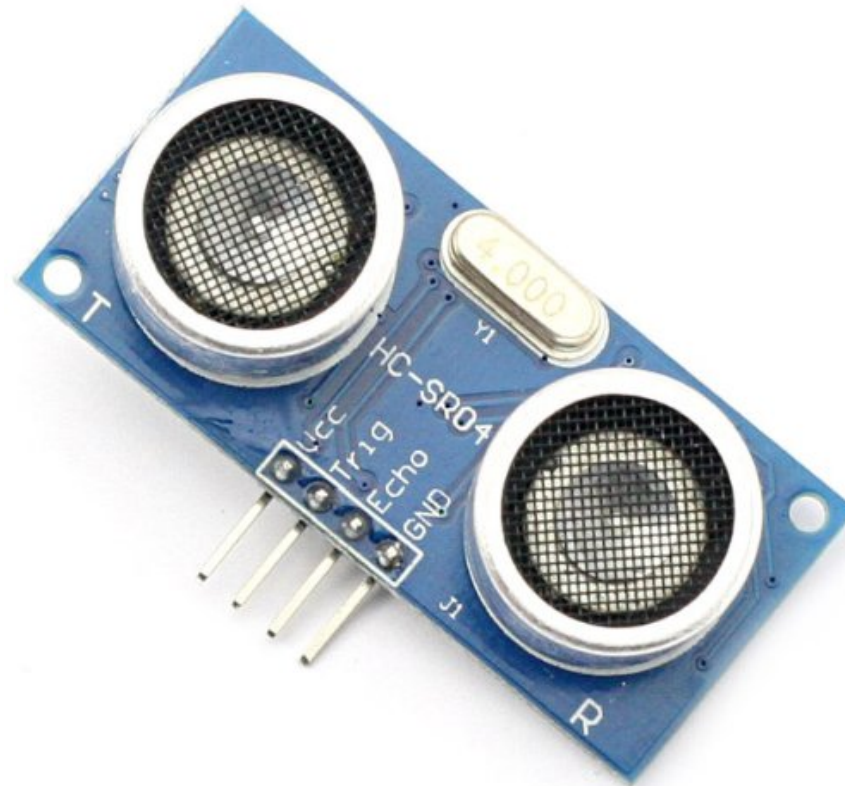
LCDs



Keypads

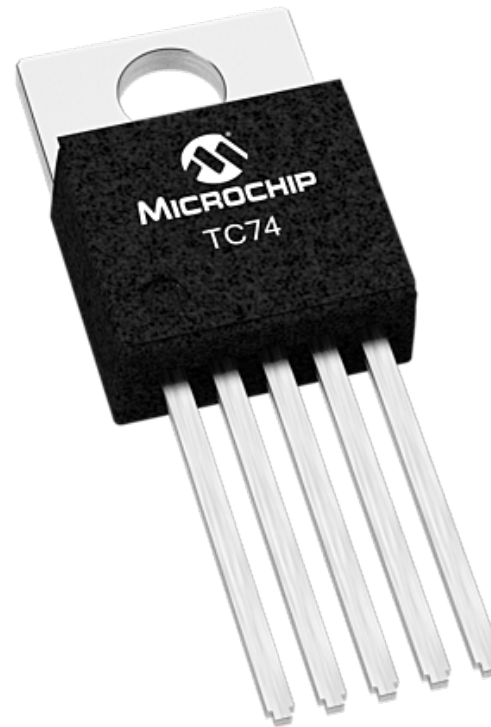
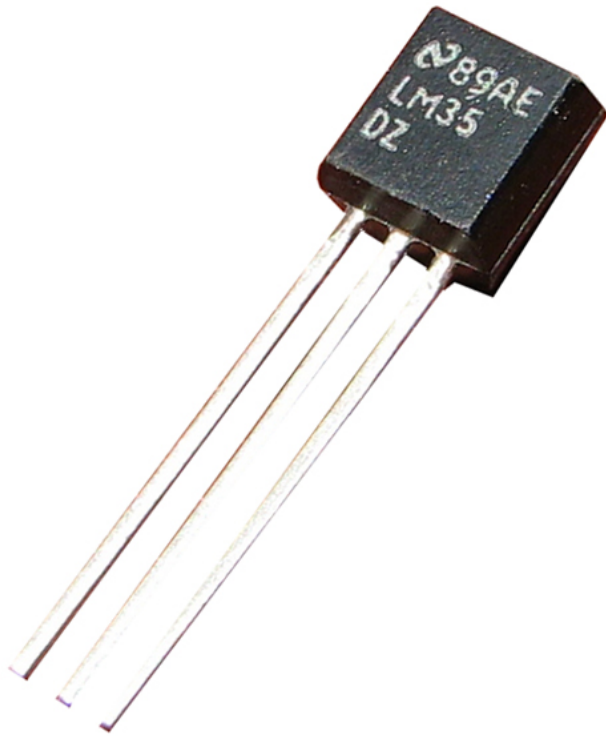


Ultrasonic Distance sensor

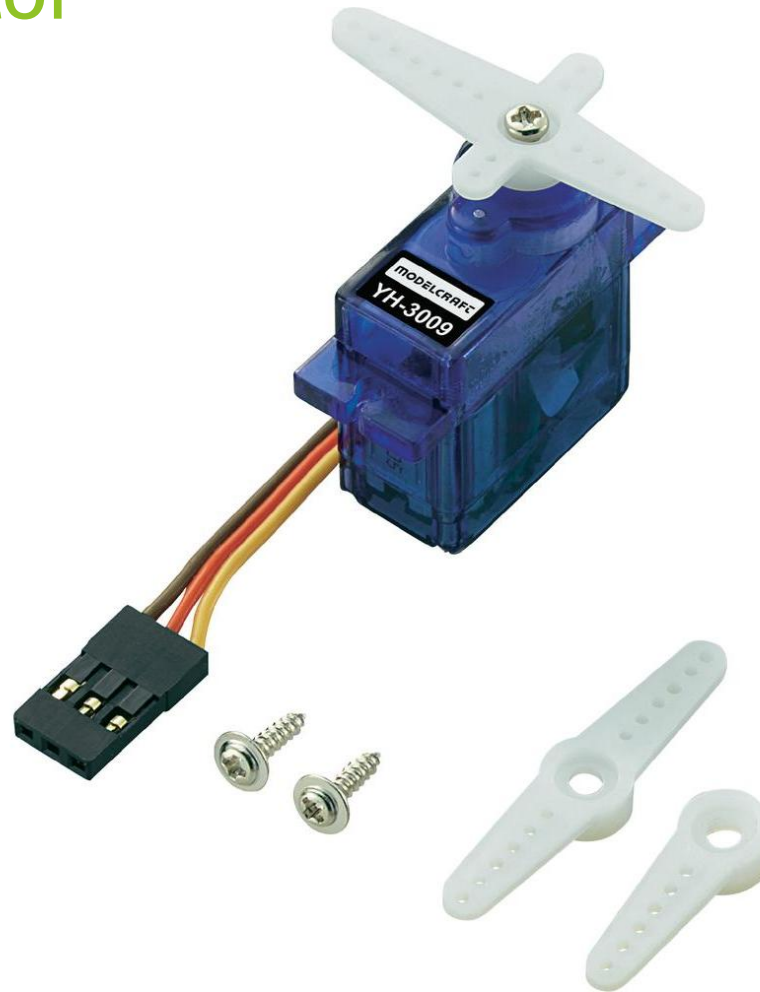


IoT = Internet of Temperature-sensors

- ▶ Analog
- ▶ Digital



Micro servo motor

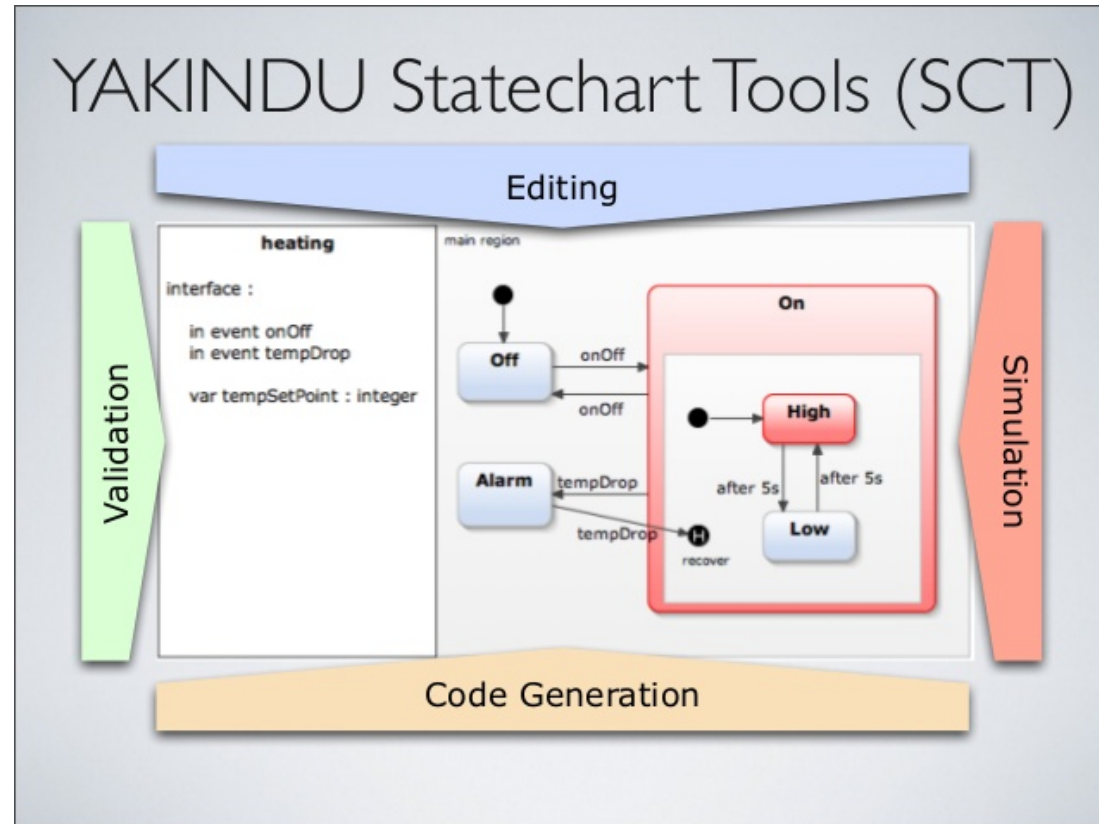


Why?

- ▶ Interfacing Hardware allows investigation of key Embedded skills
 - ▶ Basic Electronics
 - ▶ Digital I/O
 - ▶ Analog to Digital Conversion
 - ▶ Timers
 - ▶ Interrupts
 - ▶ PWM motor speed control
 - ▶ Serial communication
 - ▶ Digital Bus technologies

Statecharts...

- Once we can interface to basic hardware we have to learn how to design complex programs...



Donnerstag, 29. März 12

And then we move onto...

- ▶ The Pi
- ▶ Embedded Linux
- ▶ Bluemix
- ▶ RAD prototyping...