ITESCIA
L'ECOLE DU i-MANAGEMENT

Xilabs
smartgaming

Internet of Things
Introduction and prototyping

Ivo FLAMMER
XiLabs, octobre 2019

Contact : ivo.flammer@xilabs.fr

Internet of Things
course objectives

- Understanding IoT as a main driver of todays innovation
- **Prototyping** of an IoT on **Arduino/Processing**

Internet of Things, Ubimedia, ubiquitious computing, pervasive computing, situation awareness, context awareness, quantified self, living things

Internet of Things

course overview

Introduction

> Introduction « Internet of Things »
> Installation and introduction software (Arduino et Processing)
> Introduction sensors/ actuators, measurement and data acquisition

Exercises

> Handling of the hardware et exercises sensors / actuators
> Exercises prototyping : Arduino and web connection

IoT concept

> Reflection and conceptualization of a personal IoT

Internet of Things

Actualité

EUROPE

IoT is part of H2020 EU R&D effort.

http://www.internet-of-things-research.eu/pdf/IERC_IoT-Pan%20European%20Research%20and%20Innovation%20Vision_2011_web.pdf

FRANCE

CapDigital report, dec 2013

http://www.capdigital.com/publications/boutique/cr-living-things-du-design-a-lindustrialisation/

US

Conférence CES2014 et CES2015, Las Vegas

https://www.youtube.com/watch?v=tTHqb5RZTVg

French BLOGs

https://www.aruco.com

http://www.objetconnecte.com

Internet of Things
Actualité

CES 2014 (International Consumer Electronic Show), keynote

Cisco CEO John Chambers
believes his company's Internet of Everything (IoE) plan will alter the trajectory of virtually every person on the planet, consumer and professional alike.

Whether it's smarter power grids, personalized retail experiences, improved industrial efficiency, or the ability to control the infrastructure of an entire building with a smartphone app, IoE will be "bigger than anything that's ever been done in high tech”.

Buoyed by exponential growth in our ability to capture and analyze data, new tech will "get the right data to the right device at the right time to the right person or machine to be able to make the right decision," he declared, arguing that even seemingly inane concepts like sensor-equipped garbage cans could produce billions of dollars in efficiency-based savings.

Internet of Things
Biblio

IoT Concept

- The Internet of Things: Connecting Objects, by Hakima Chaouchi (Editor) Wiley, 2013
- Internet of Things - Global Technological and Societal Trends From Smart Environments and Spaces to Green ICT, Ovidiu Vermesan & Peter Friess, River Publishers, 2011
- The Emerging Domain of Cooperating Objects: Definitions and Concepts, Pedro José Marrón, Daniel Minder, Stamatis Karnouskos, Springer 2012
- Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Florian Michahelles, Springer 2011

IoT legal aspects

- Internet of Things: Legal Perspectives, Rolf H. Weber, Romana Weber, Springer, 2010

IoT and Arduino

- Programming Arduino Next Steps: Going Further with Sketches, Simon Monk, 2013
- Making Things Talk: Using Sensors, Networks, and Arduino to See, Hear, and Feel your World, By Tom Igoe, O'Reilly Media, 2011

Internet of Things
DEFINITION

Internet of Things

An object including
a) A local connection(situation / context awareness)
b) A global connection

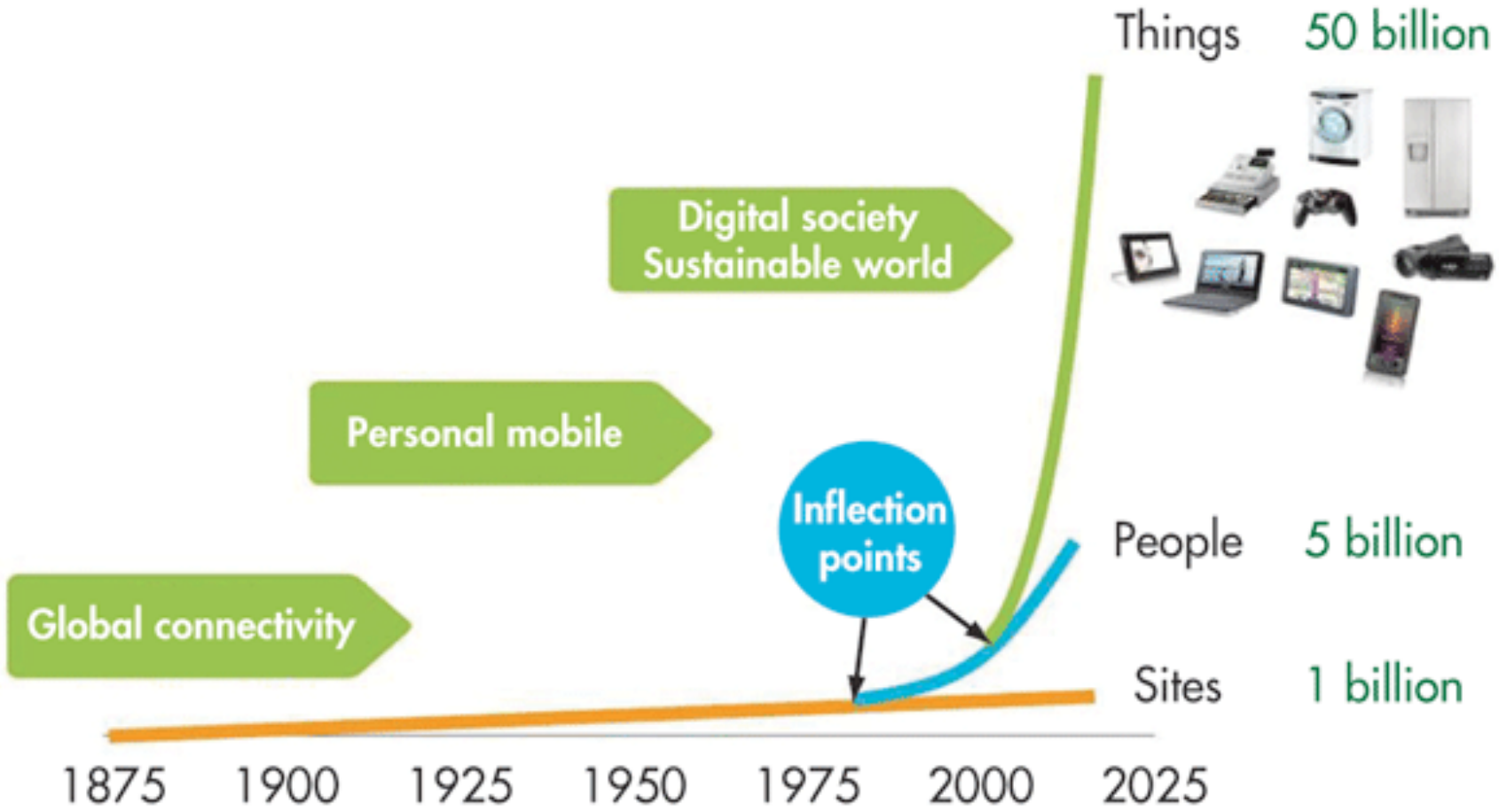
→ Objet connecting the local to the global is not only an intelligent, but an aware object

→ is *transforming the physical world itself into an information and knowledge system*

→ *smart planet where the physical, digital and virtual worlds are converging* to create smart environments that would make energy, transport, cities and many other areas more intelligent are enormous.

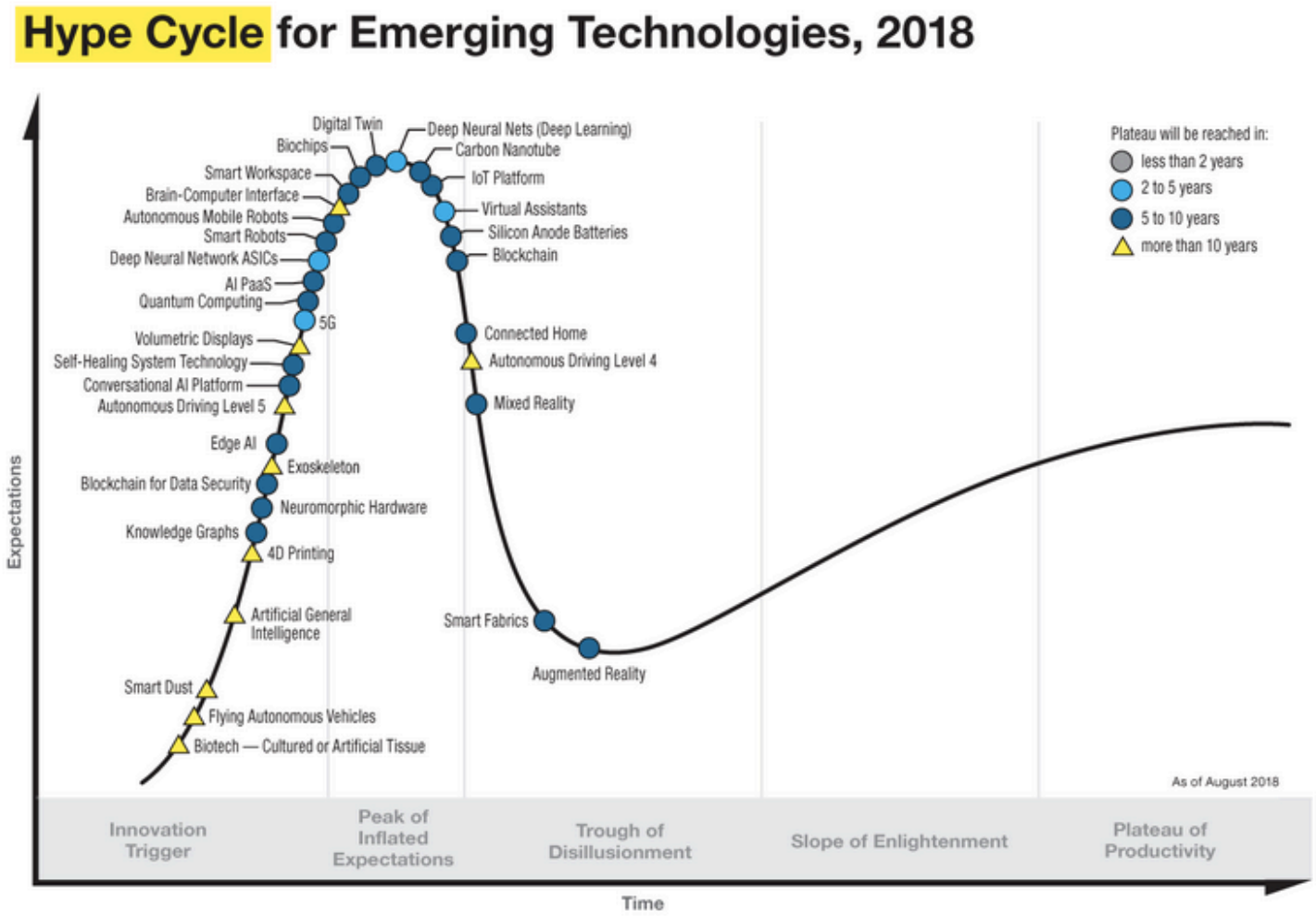
Internet of Things

Quantitative evolution



Source: electronic design, 2013

Innovation



gartner.com/SmarterWithGartner

Source: Gartner (August 2018)

Gartner

Internet of Things
Recap

INTERNET OF THINGS

> All kind of objects and entities become “smart”
smart : intelligent and connected a) locally, b) internet

→ **awareness** (context awareness, situation awareness)
Cities, Cars, streets, scales, phones, water,…

> Interfaces to real world by local connection : **sensors and actuators**
> Connection to internet: cable, RF (WiFi, NFC, sensor networks),
cloud, WASN : wireless autonomous sensor networks

Red Flag : SIZE. power autonomy and network connection (BLE, Sigfox, LORA, 4G LTE Cat 0 et PSM Power saving mode)
Green Flag : Easy and cheap prototyping (3D printers, micro-nano sensors and actuators, 4G, Arduino, RasberryPi)

Internet of Things
Application domains

A smart Home where no energy is wasted, where interactive walls are able to display useful information, as well as pictures of art, videos of faraway friends or relatives

In Samsung's smart-home vision, screens will provide recipes, notifications, and reminders as well as entertainment.

Source: Alessandro Bassi, EU usecase workshop, 2013

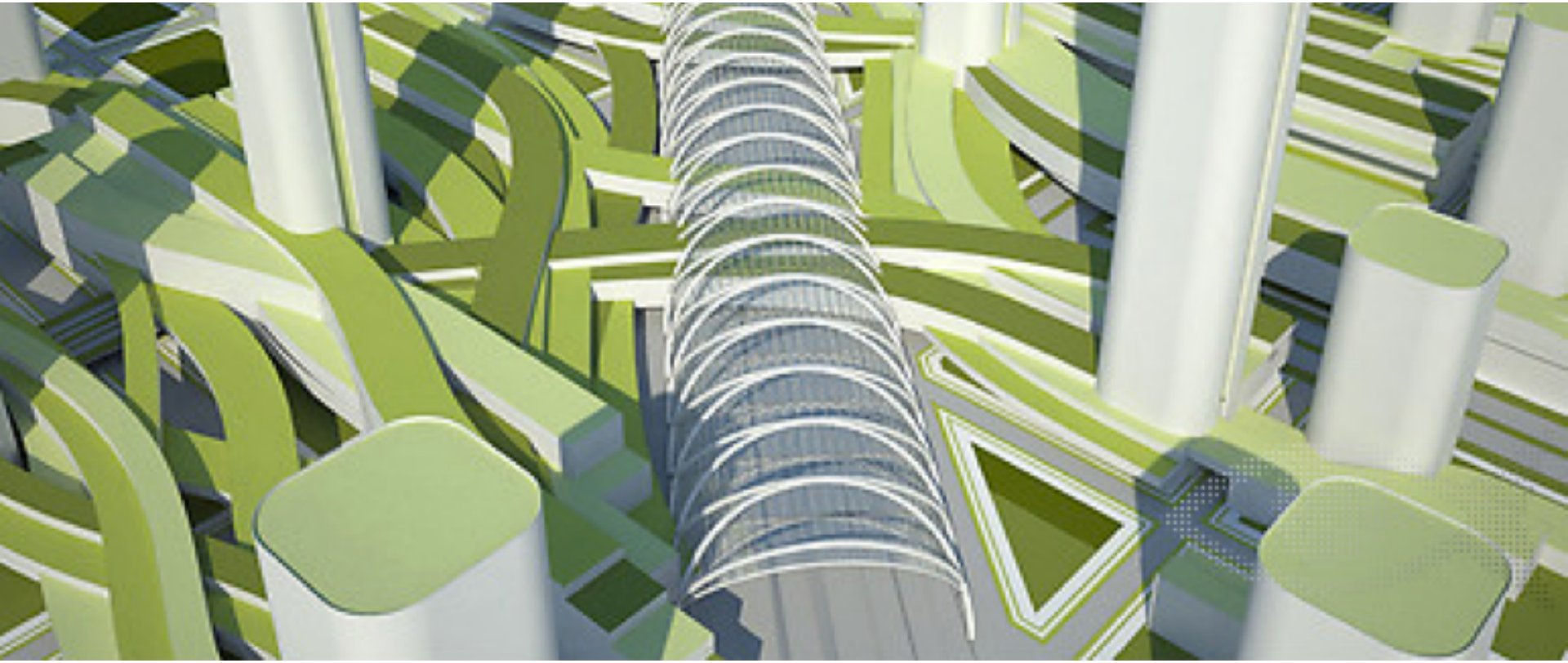
Internet of Things
Application domains

Productive business environment where offices become smart and interactive, where factories relay production-related data in real-time, where face-to-face meetings are established through holograms and where documents are fully integrated in the workflow

Source: Alessandro Bassi, EU usecase workshop, 2013

Internet of Things
Application domains

Smart Cities, where productive areas, retail, residential and green spaces will coexist and will be enhanced by IoT technologies



Source: Alessandro Bassi, EU usecase workshop, 2013

Internet of Things
Application domains

Efficient logistics environment where safety and environmental concerns are ubiquitously embedded into the process

Source: Alessandro Bassi, EU usecase workshop, 2013

Internet of Things

Application domains

Smart health, nonintrusive monitoring system, preventing serious illness by adjusting the environment and selecting appropriate drugs and diet.

Source: Alessandro Bassi, EU usecase workshop, 2013

Internet of Things
Application domains

Intelligent Transportation Sytems where public and private transportation interacts, choosing the best path to avoid delays and congestions, and where multimodal transport is smooth and easy

Source: Alessandro Bassi, EU usecase workshop, 2013

Internet of Things
Application domains

Ultimate retail environment where consumers are supported to have a healthy and convenient shopping experience, where full traceability of products is standard.

Source: Alessandro Bassi, EU usecase workshop, 2013

Internet of Things

Examples Quantified Self / life logging

Movement to incorporate technology into data acquisition on aspects of a person's daily life.

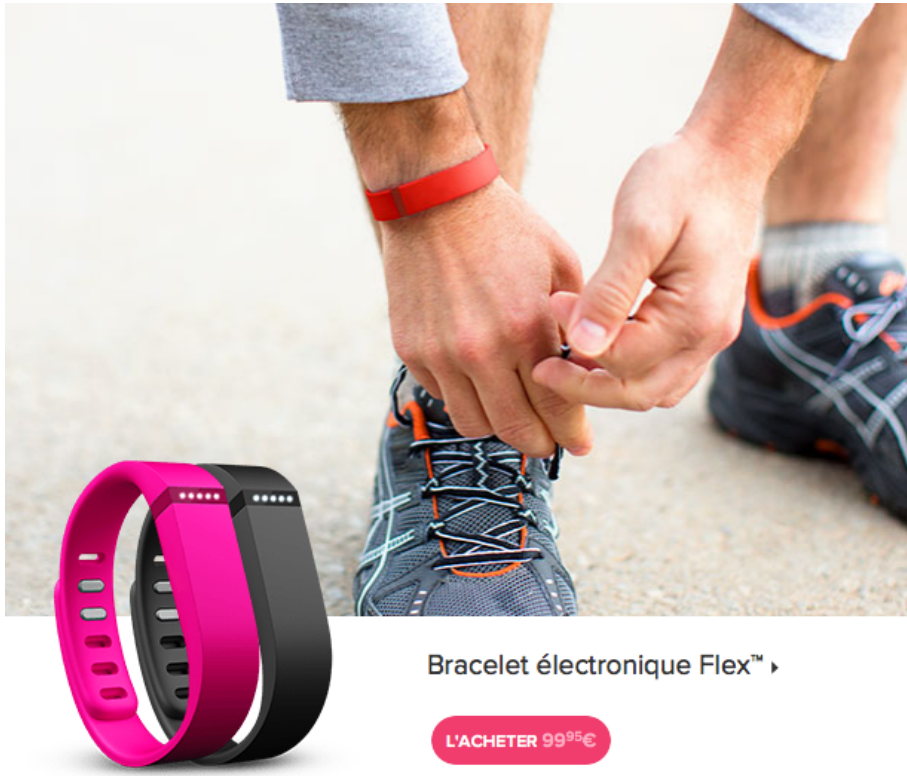
→ self-tracking / life logging / wearable computing

4 examples :
> Fitbit
> Memoto
> Kapture
> Withings
> Google glasses

Internet of Things
Examples Quantified Self

Fitbit

Fitbit is a small device to track your physical activity or sleep. You can wear the device all day because it easily clips in your pocket, pants, shirt, bra, or to your wrist when you are sleeping. The data collected is automatically synched online when the device is near the base station. After uploading, you can explore visualizations of your physical activity and sleep quality on the web site. You can also view your data using their new mobile web site. You can also track what you eat, other exercises that you do, and your weight.

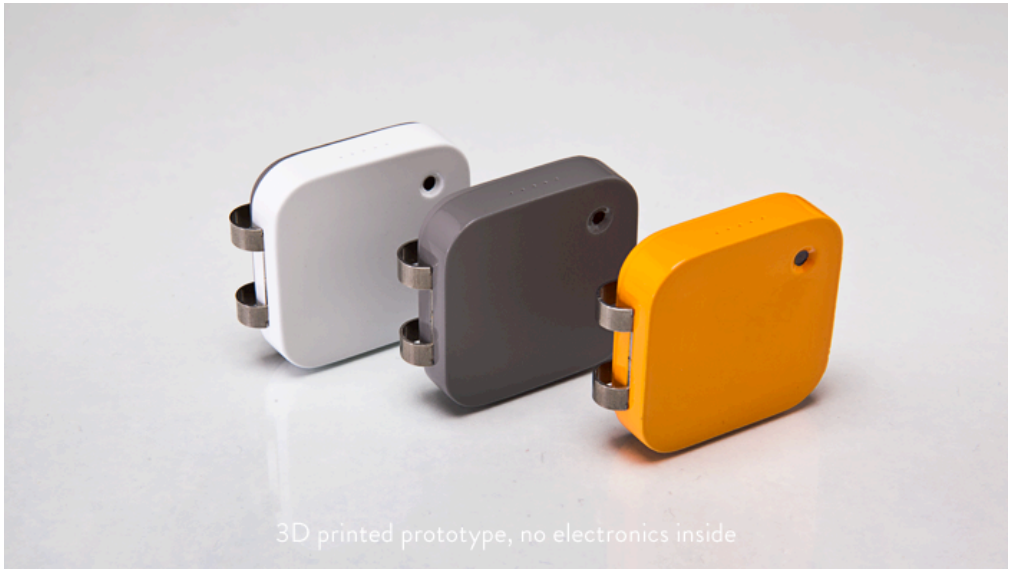


Internet of Things
Examples Quantified Self

Memoto

→ The device takes a photograph every 30 seconds and sends it up to internet.
→ is worn with a clip on shirt or a jacket

Sensors : GPS + camera
500k$ Kickstarter campaign
(50k$ pledged)



Internet of Things
Examples Quantified Self

Kapture

Bracelet, which continuously registers the last 60 seconds of ambient sound. If you lived en exceptional sound moment, you tap on the bracelet and the last 5 seconds are sent and logged on to internet. (If you pay for it, the last 60 seconds are sent up)

Internet of Things
Examples Quantified Self

Withings

Measures body health parameters (weight, heart rate) and aggregates the data on internet. You can access them by a mobile application.

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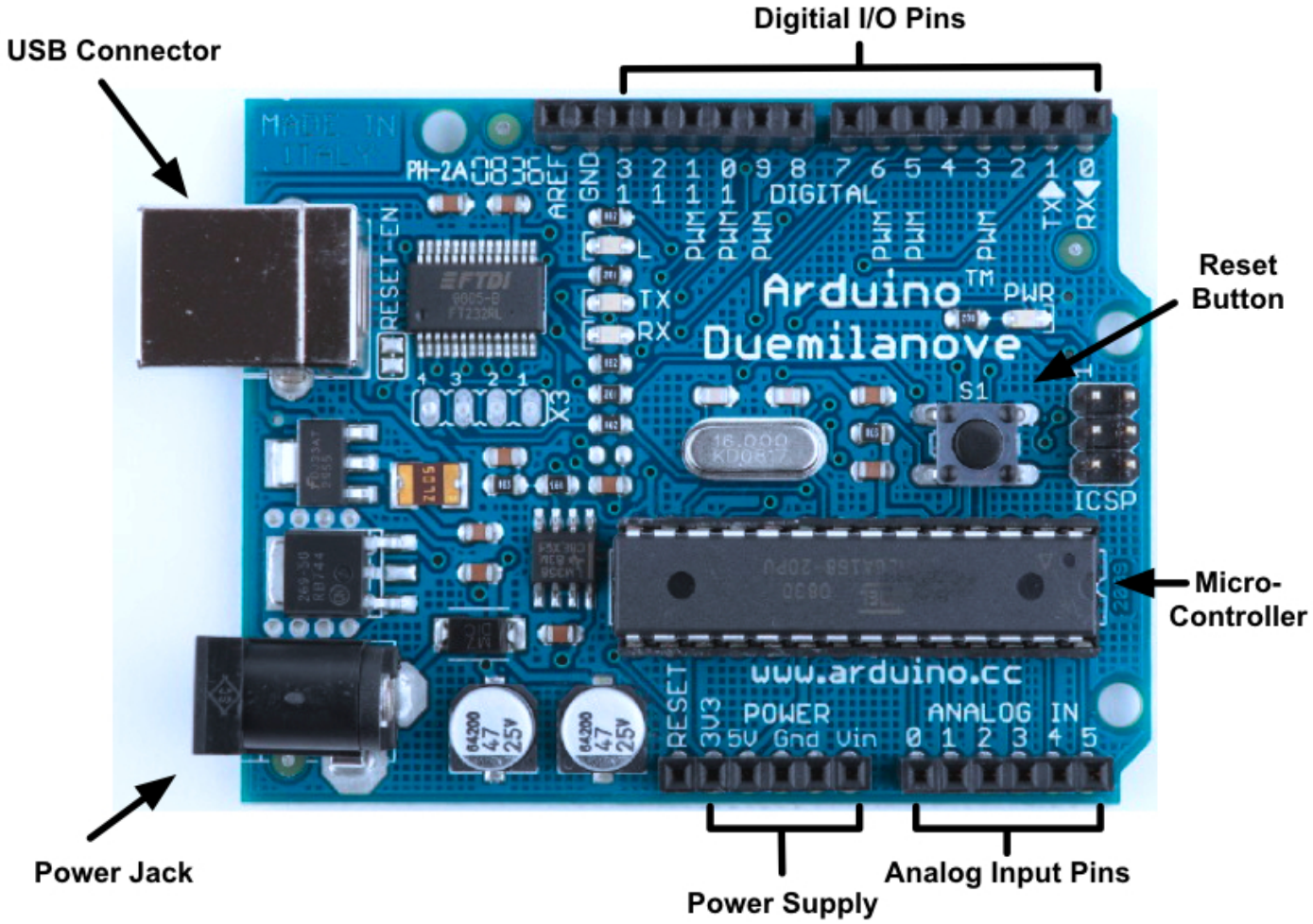
Rapid Prototyping : Arduino



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Rapid Prototyping : Arduino

Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the board is programmed using the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing).

Arduino projects can be stand-alone or they can communicate with software running on a computer (e.g. Flash, Processing, MaxMSP). Arduino is a programming language, development environment, and online community.

Internet of Things

Rapid Prototyping : Arduino

http://arduino.cc/

Positif

> RELIABLE
> SUPPORT Huge and active internet community
> OPEN SOURCE
> CHEAP (30€)
> SIMPLE : java
> VERSATILE
> EUROPEAN

Negatif

> Limité en mémoire (Arduino MEGA, external storage)
> Lent (souvent pas un problème)
> Grand (doit être reduit après phase de prototypage, Arduino LilyPad, Mini, Nano)

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Arduino codage

```
/*
  Blink
  Turns on an LED on for one second, then off for one second, repeatedly.
 This example code is in the public domain.
 */

// Pin 13 has an LED connected on most Arduino boards.
// give it a name:
int led = 13;

// the setup routine runs once when you press reset: COMPULSORY
void setup() {
  // initialize the digital pin as an output.
  pinMode(led, OUTPUT);
}

// the loop routine runs over and over again forever: COMPULSORY
void loop() {
  digitalWrite(led, HIGH);   // turn the LED on (HIGH is the voltage level)
  delay(1000);               // wait for a second
  digitalWrite(led, LOW);    // turn the LED off by making the voltage LOW
  delay(1000);               // wait for a second
}
```

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Arduino codage

How to stop the program running on Arduino ?

> Deconnect and reconnect USB cable (…)

> Reset Arduino button (…)

How to debug on Arduino ?

Use serial monitor and send some messages on serial port.

Use *Serial.println("Hello Debug");*

Don’t forget to instanciate / setup Serial class *Serial.begin(9600);*

You don’t get any error if you forget this.

> There is a Auto-Format function to get code more lisible. Tools - AutoFormat

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Arduino codage

Programming Arduino is very simple

There are Structures, Variables and Functions :
Have look here

http://arduino.cc/en/Reference/HomePage

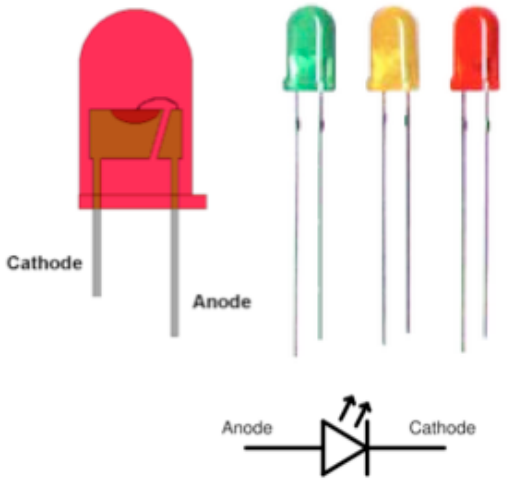
Internet of Things
LED

Description

Standard color LED. Electroluminescent diodes (LED) emit light.
LED is polarized. Use it in the correction direction. Long leg : « + », short one is « - » and connects to the ground.

Features

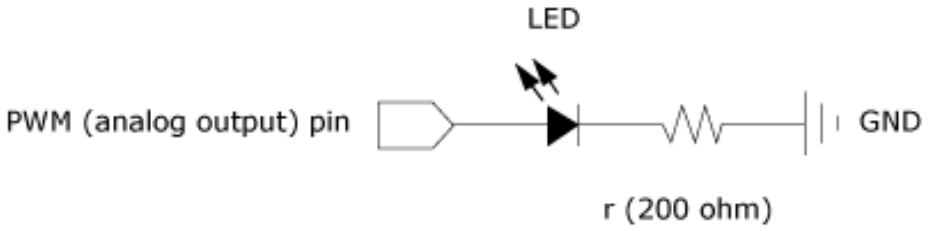
* 1.8-2.2VDC forward drop
* Max current: 20mA
* Suggested current: 16-18mA
* Luminous Intensity: 150-200mcd

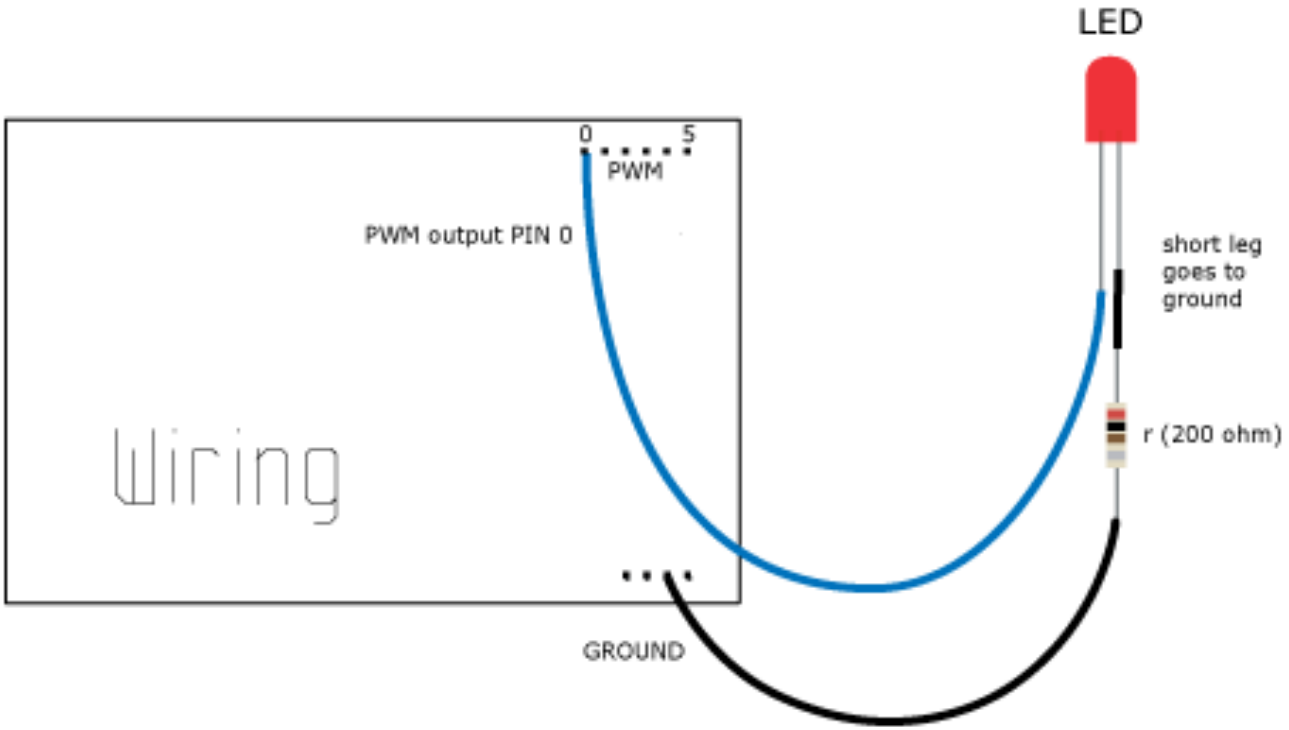


Absolute Maximum Ratings: (Ta=25℃) .

ITEMS	Symbol	Absolute Maximum Rating	Unit
Forward Current	I_F	20	mA
Peak Forward Current	I_{FP}	30	mA
Suggestion Using Current	I_{su}	16-18	mA
Reverse Voltage (V_R=5V)	I_R	10	uA
Power Dissipation	P_D	105	mW
Operation Temperature	T_{OPR}	-40 ~ 85	℃
Storage Temperature	T_{STG}	-40 ~ 100	℃
Lead Soldering Temperature	T_{SOL}	Max. 260℃ for 3 Sec. Max. (3mm from the base of the expoxy bulb)	

Internet of Things
LED



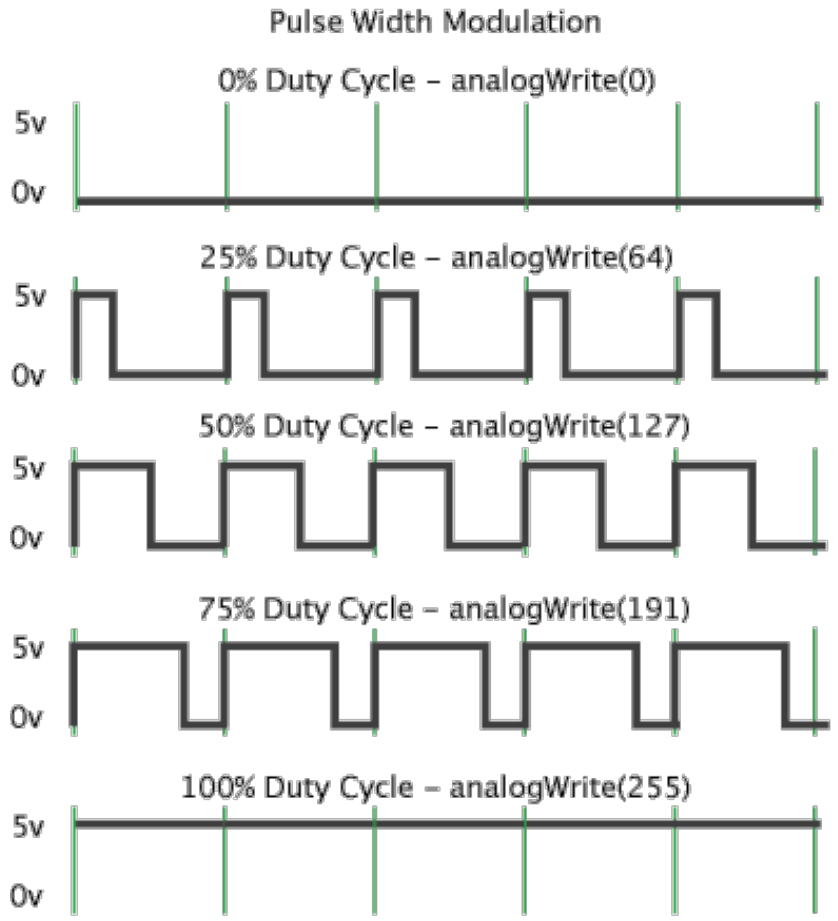


Internet of Things
Analog output

analogWrite();

Uses Pulse Width Modulation

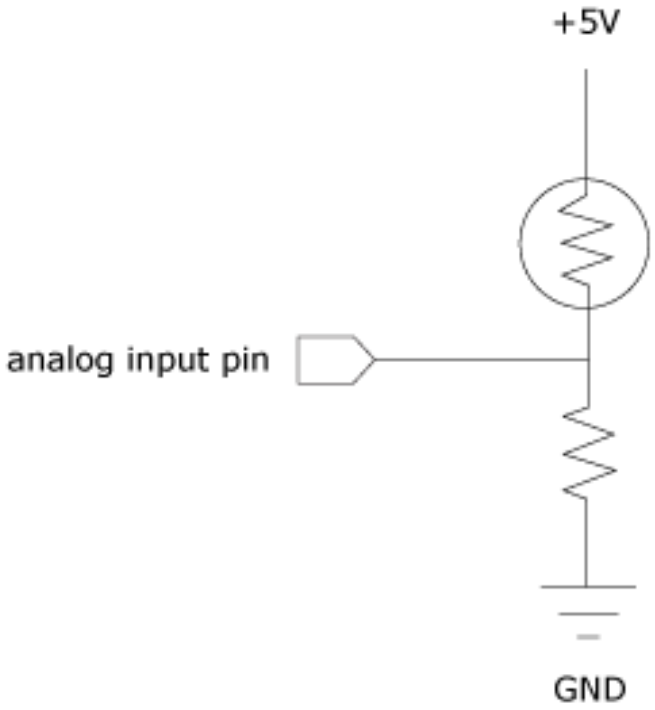
Just do it fast enough….



Internet of Things

Basic electric scheme

Electric scheme for resistance based sensors



Internet of Things

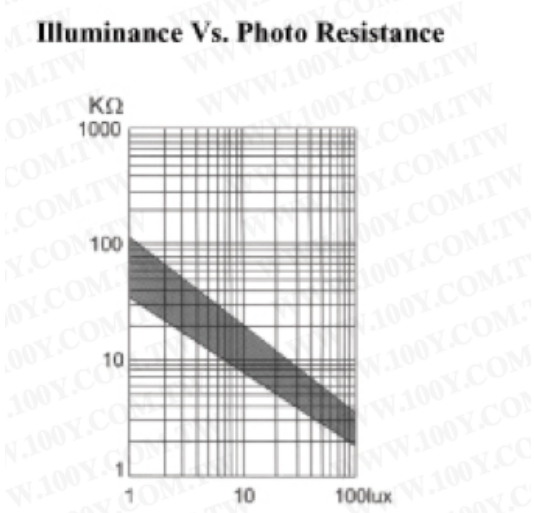
Sensors : Photocell

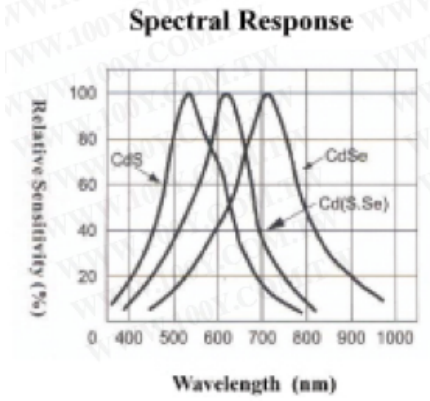
Description

Small photocell. A photocell changes resistance depending on the amount of light it is exposed to.

Features

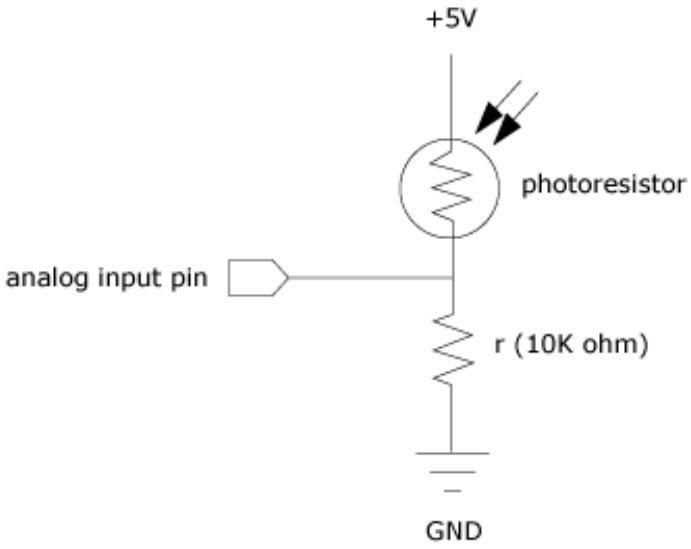
* Light resistance : ~1k Ohm
* Dark resistance : ~10k Ohm
* Max voltage : 150V
* Max power: 100mW

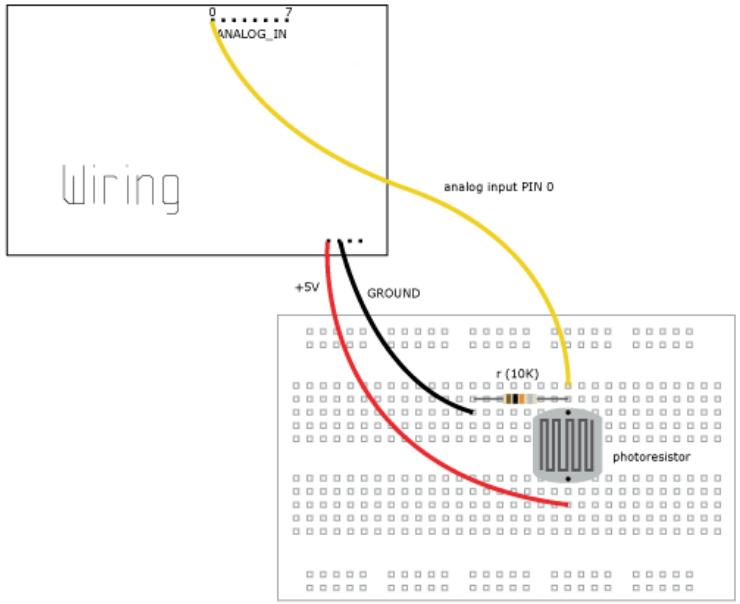




Internet of Things

Sensors : Photocell





From: http://www.wiring.org.co

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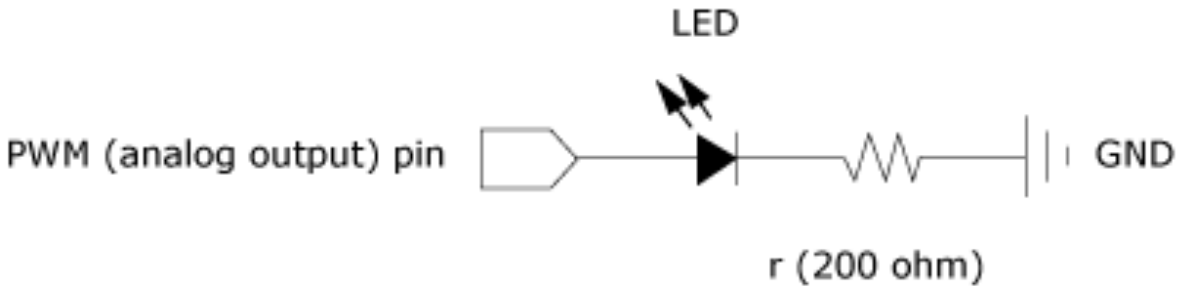
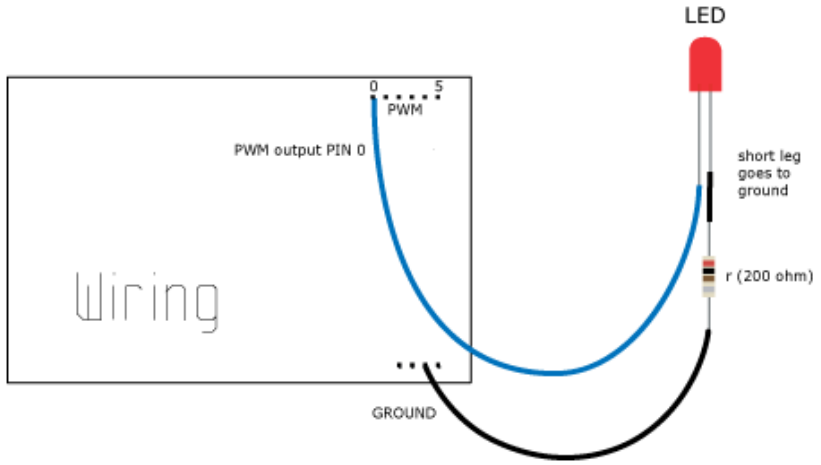
Actuator : single color LED



Arduino output voltage :

I/O pins : 5V max

Regulated outputs 3.3V and 5V



Arduino output current :

> 40mA (I/O pins)

> 200mA on VCC-GND, 5V

> 50mA on VCC-GND, 3.3V

Internet of Things
Rapid Prototyping

ARDUINO PORTS	INPUT	OUTPUT
ANALOG	0 – 5V (or AREF) input **Sensors** which have a varying signal. Resistive sensors, flex,… *analogRead();* *ports A0-A5*	Only exists as **PWM** output **Actuators** which process electronic signals between 0 and 5V. Loudspeaker, heating wire, *analogWrite(0-255);* *ports 0-13 with tilde*
DIGITAL	either 0V or 5V **Sensors** which have digital signal of I2C/SPI sensors, button, *digitalRead();* *ports 0-13*	either 0V or 5V **Actuators** which process digital electronic signals I2C/SPI actuators, LED, relay *digitalWrite(0/1, HIGH/LOW);* *ports 0-13*

Arduino vs Raspberry

Arduino
Easier to use
Best for simple, repetitive tasks
More versatile sensor input/output ports
More robust in experimental conditions
Miniature version available
-> Our choice for IoT

Raspberry Pi
Full fledged computer, with very low price
Needed for multimedia applications
Needed for use as Web server
Web connection integrated

Internet of Things
Connexion web

Séance Procesisng / internet

- Arduino et Processing
- Exercices prototypage : Arduino et connexion web

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Processing

http://processing.org/

Processing is a programming language, development environment, and online community. Since 2001, Processing has promoted software literacy within the visual arts and visual literacy within technology. Initially created to serve as a software sketchbook and to teach computer programming fundamentals within a visual context, Processing evolved into a development tool for professionals. Today, there are tens of thousands of students, artists, designers, researchers, and hobbyists who use Processing for learning, prototyping, and production. -

PATCH : Processing on desktop gives us the ineternet connection
EASE : Easy to connect to Arduino, see
http://playground.arduino.cc/interfacing/processing

Use of Arduino in this course is done with 2 patches

Autonomy

Arduino can be perfectely autonomous, just add external battery 9V

→ We use power from PC, through USB connection

Connection

Use Arduino connection shields, WiFi / BT / GSM

→ We connect Arduino to desktop computer. The computer connects to internet and communicate in serial way.

Processing is used to connect to Internet and to communicate with Arduino

2 methods to communicate between Arduino and Processing

1. Use serial communication APIs on both sides, create user code on Arduino and on Processing.
2. **Install Firmata on Arduino.** Firmata program implements Arduino functions to be called from Processing. Code is only written on Processing side. (slower but simpler)

> Install and run Firmata on Arduino

> Code on Processing

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Processing codage

```
import processing.serial.*;                                  //import serial communication classes
import cc.arduino.*;                                         //import  Arduino classes

Arduino arduino;                                             //declare an Arduino object
int ledPin = 13;

void setup()                                                 // runs once at start
{
  //println(Arduino.list());                                 // use this to get port#
  arduino = new Arduino(this, Arduino.list()[0], 57600);     //instanciate own Arduino object
                                                             // COM port number and baudrate
  arduino.pinMode(ledPin, Arduino.OUTPUT);
}

void draw()                                                  //loops forever
{
  arduino.digitalWrite(ledPin, Arduino.HIGH);
  delay(1000);
  arduino.digitalWrite(ledPin, Arduino.LOW);
  delay(1000);
}
```

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Processing codage

How to stop the program running on Arduino / Processing ?
> Tell stop to Processing
(Arduino Firmata is still running)

How to debug on Processing ?
Use serial monitor and send some messages on serial port.
Use *println(ledPin);* to print on console

> This is very similar to Arduino interface and code …. somewhat confusing

Internet of Things
Processing codage

The Processing Language was designed to facilitate the creation of sophisticated visual structures.

Very Java like
The Processing environment is written in Java. Programs written in Processing are translated to Java and then run as Java programs.

Large distinctions between Processing and Java are the Processing graphics library and a simplified programming style that doesn't require users to understand more advanced concepts like classes, objects, or animations.

Have look at the references
http://www.processing.org/reference/

Internet of Things
Hardware

Sensors and actuators

> Measurement basics
> Sensor and actuators on Arduino
> Prototyping of sensor/actuator project

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Measurement basics

1. SENSOR DEFINITION
2. BASIC SENSOR SIGNAL PROCESSING SCHEME
3. SENSOR – ACTUATOR

How many sensors are in this room ?

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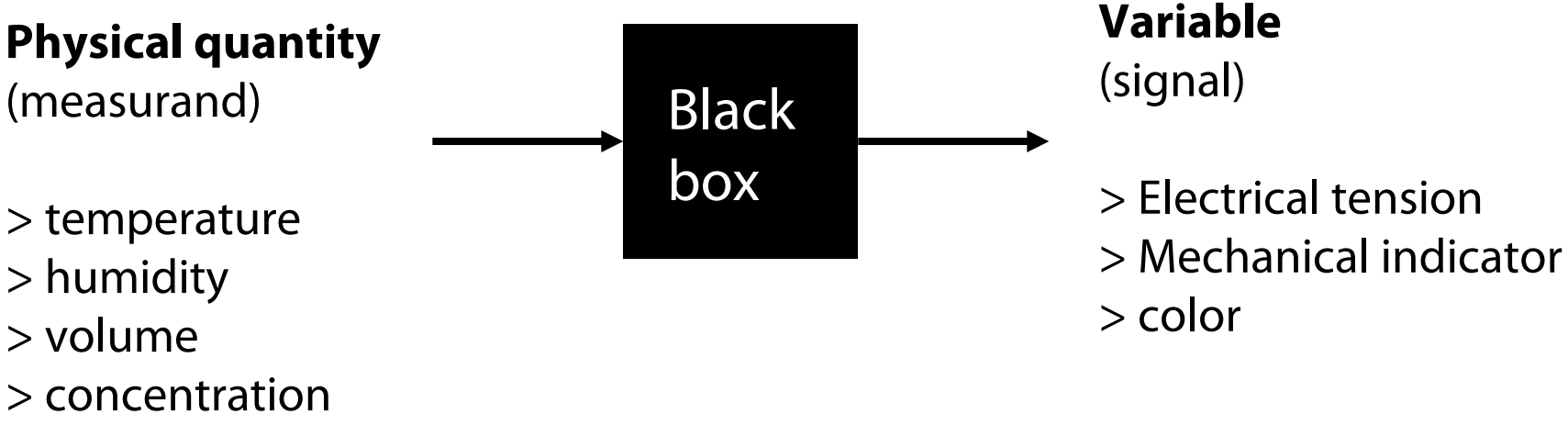
Sensor examples

SENSORS Contemporary applications / Gaming

SENSORS contemporary applications / military

Definition

A sensor transforms a physical quantity into a readable variable



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Sensors definition

MERRIAM-WEBSTER: a device that responds to a physical stimulus (as heat, light, sound, pressure, magnetism, or a particular motion) and transmits a resulting impulse.

WIKITUDE : A sensor is a converter that measures a physical quantity and converts it into a signal which can be read by an observer or by an (today mostly electronic) instrument.

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Sensors terminology

French : capteur

Detector

Same as a sensor

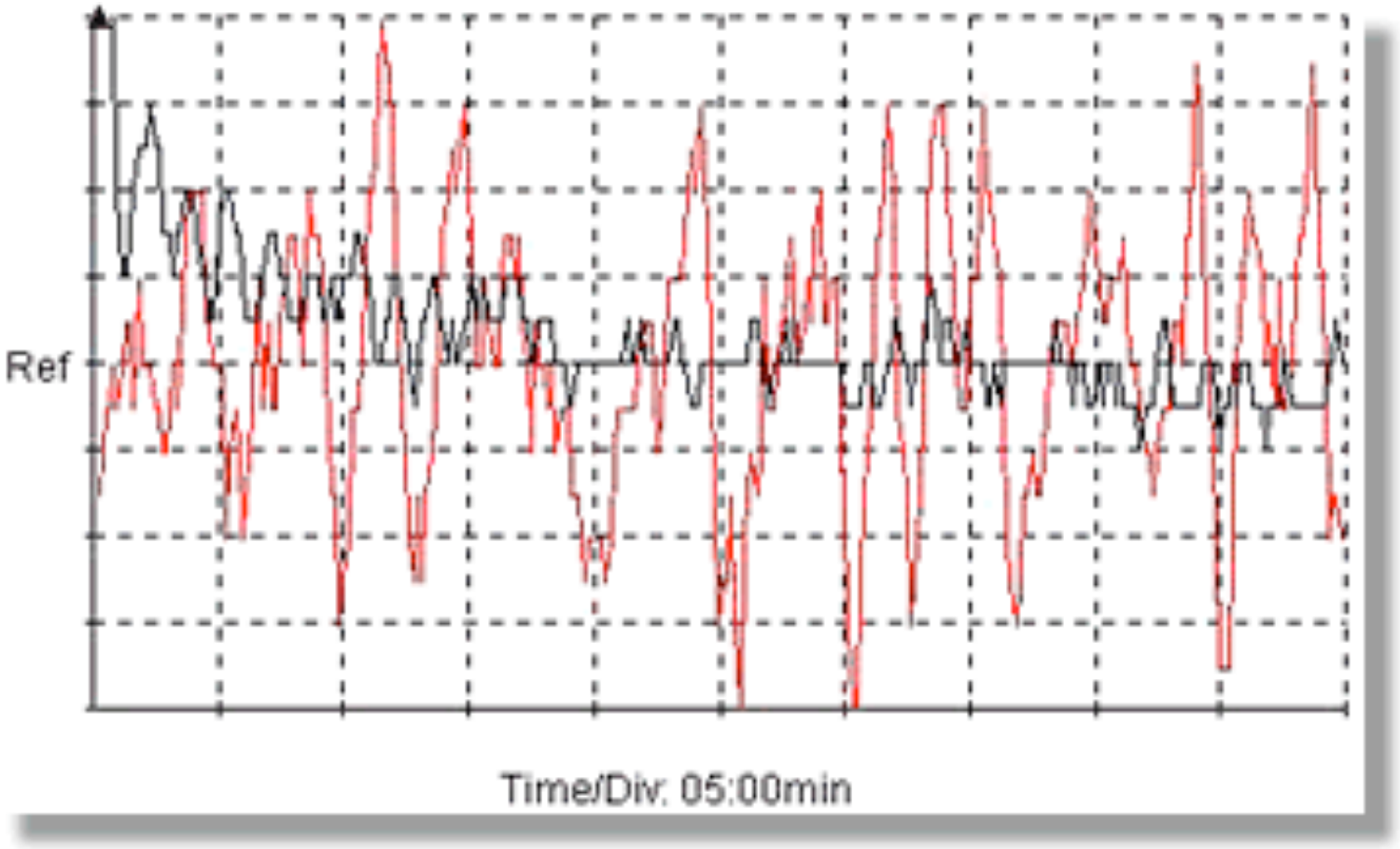
Transducer

Transducer is a device that transfers power from one system to another in the same or in the different form

Actuator

The opposite of a sensor

Temporal measurement series

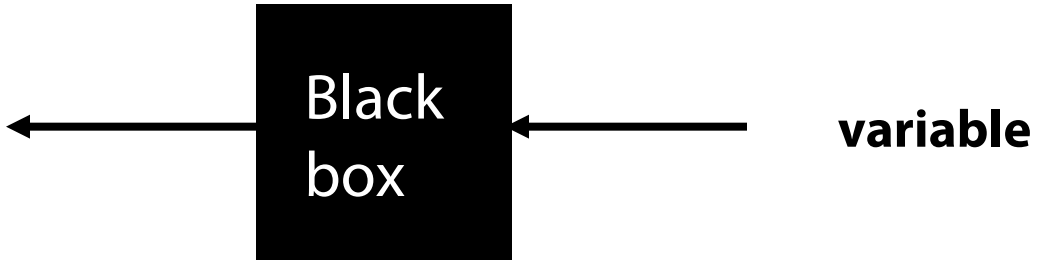


Actuator Definition

An actuator transform a variable into a physical quantity

Physical quantity

> temperature
> humidity
> volume
> concentration



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Sensors are hype

Trillion Sensor Summit, California, oct 2016

The TSensors (Trillion Sensors) Summit is an event being organized as a forum for world sensor visionaries to present their views on which sensor applications and sensor types have potential to fuel sensor market growth to trillions by 2023, and why. Their visions will form a foundation for a Trillion Sensor Roadmap, which sensor experts consider instrumental in acceleration of development and commercialization of sensors supporting global changes in the coming decade, thus accelerating Abundance[1].

http://www.tsensorssummit.org

WORLD OF SENSORS

UBIQUITY

- Sensors are everywhere !!

POWER OF STATISTICS

- Control starts with **quantification**
- There is a very strong tendency to quantify, aggregate and analyze (correlate) real world data.

Internet of Things
Overview Session 2

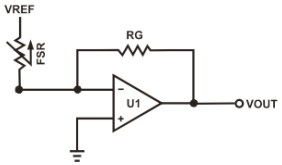
Sensors and actuators

> Measurement basics
> Sensor and actuators on Arduino
> Prototyping of sensor/actuator project

Internet of Things
Multiple Transformations

In order to connect a sensor to a computer, we need to transform his physical response into a digital value

steps

T  **R** 

V 

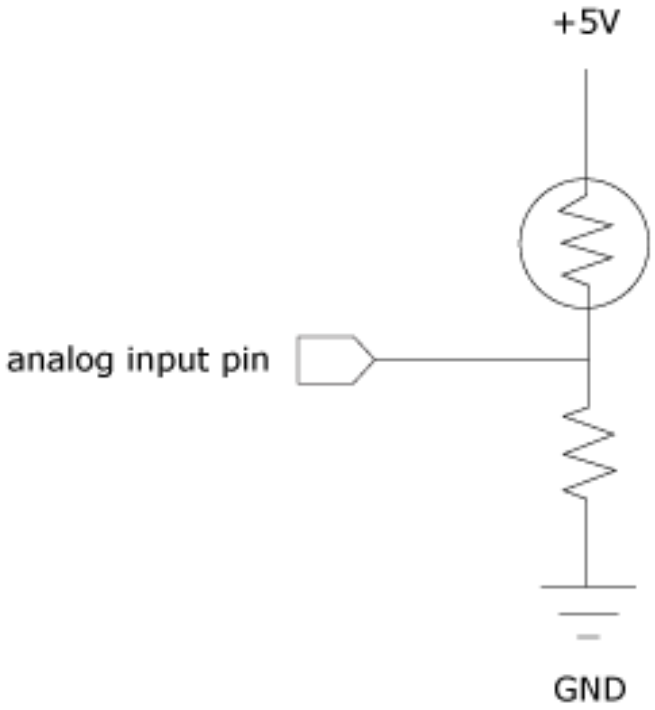
8bit  **variable T, float**

Sensor resistance varies with temperature → Conversion into an electrical tension → ADC → computer

Internet of Things

Basic electric scheme

Electric scheme for resistance based sensors



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Sensors : Thermistor

Description

10K thermistor with a negative temperature coefficient. For temperature sensing applications.

Formula

Resistance en fonction de la temperature

$$R(T) - R_{ref} \times e^{(A + B/T + B/T^2 + C/T^3)} \qquad (1)$$

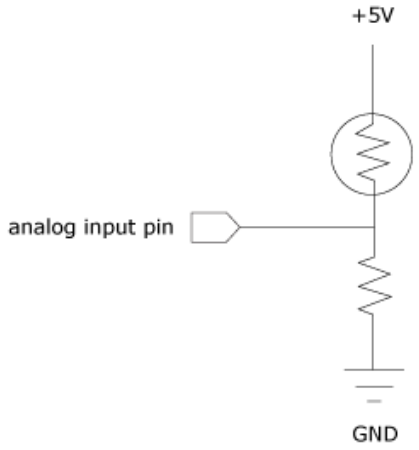
$$T(R) = \left(A_1 + B_1 \ln\frac{R}{R_{ref}} + C_1 \ln^2\frac{R}{R_{ref}} + D_1 \ln^3\frac{R}{R_{ref}}\right)^{-1} \qquad (2)$$

Internet of Things

Sensors : Thermistor

ELECTRICAL DATA AND ORDERING INFORMATION								
R_{25}	$B_{25/85}$ - VALUE		UL APPROVED	12NC ORDERING CODE 2381 640 6.... (1)	SAP MATERIAL NO. NTCLE100E3..... (2)	COLOR CODE (3)		
[Ω]	[K]	[± %]	[Y/N]			I	II	III
680	3560	1.5	N	*681	681*B0	Blue	Grey	Brown
1000	3528	0.5	N	*102	102*B0	Brown	Black	Red
1500	3528	0.5	N	*152	152*B0	Brown	Green	Red
2000	3528	0.5	N	*202	202*B0	Red	Black	Red
2200	3977	0.75	Y	*222	222*B0	Red	Red	Red
2700	3977	0.75	Y	*272	272*B0	Red	violet	Red
3300	3977	0.75	Y	*332	332*B0	Orange	Orange	Red
4700	3977	0.75	Y	*472	472*B0	Yellow	Violet	Red
5000	3977	0.75	Y	*502	502*B0	Green	Black	Red
6800	3977	0.75	Y	*682	682*B0	Blue	Grey	Red
10 000	3977	0.75	Y	*103	103*B0	Brown	Black	Orange
12 000	3740	2	Y	*123	123*B0	Brown	Red	Orange
15 000	3740	2	Y	*153	153*B0	Brown	Green	Orange
22 000	3740	2	Y	*223	223*B0	Red	Red	Orange
33 000	4090	1.5	N	*333	333*B0	Orange	Orange	Orange
47 000	4090	1.5	N	*473	473*B0	Yellow	Violet	Orange
50 000	4190	1.5	N	*503	503*B0	Green	Black	Orange
68 000	4190	1.5	N	*683	683*B0	Blue	Grey	Orange
100 000	4190	1.5	N	*104	104*B0	Brown	Black	Yellow
150 000	4370	2.5	Y	*154	154*B0	Brown	Green	Yellow
220 000	4370	2.5	Y	*224	224*B0	Red	Red	Yellow
330 000	4570	1.5	N	*334	334*B0	Orange	Orange	Yellow
470 000	4570	1.5	N	*474	474*B0	Yellow	Violet	Yellow

Schema électronique



Internet of Things

Sensors : Flex Sensor

Description

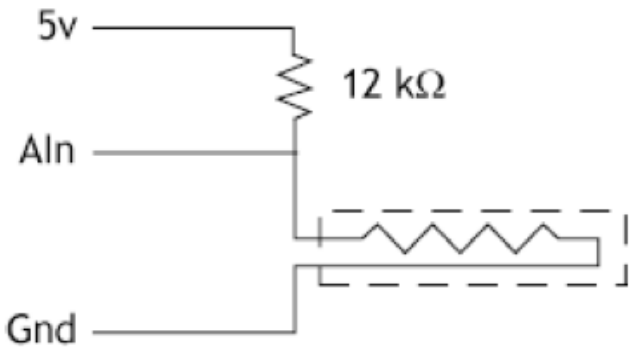
Simple flex sensor. As the sensor is flexed, the resistance across the sensor increases. These sensors were used in the original Nintendo Power Glove.

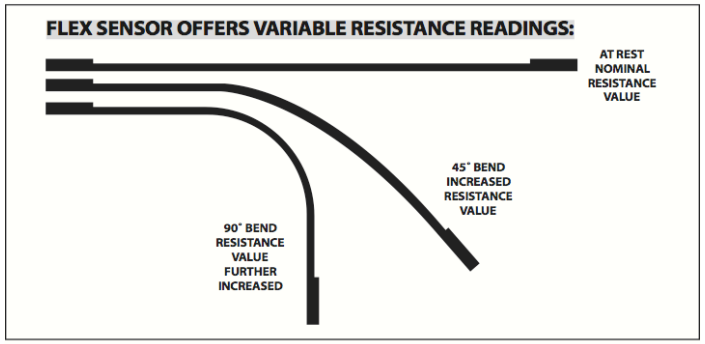
The resistance of the flex sensor changes when the metal pads are on the outside of the bend (text on inside of bend).

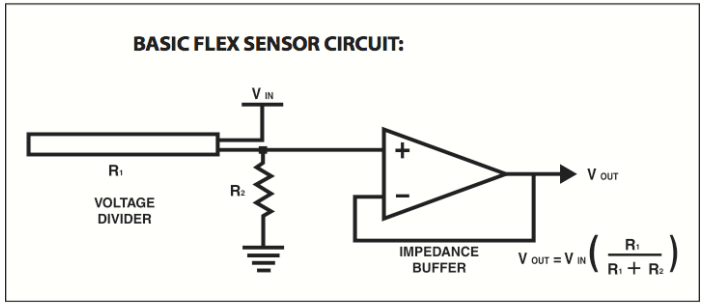
Straight (unflexed) resistance: ~9000 Ohm
90 degree bend resistance: ~14000 Ohm
180 degree bend resistance : ~22000 Ohm

Internet of Things

Sensors : Flex sensor







Internet of Things

Sensors : Force sensitive resistor

Description

Force sensitive resistor with a round, 0.5" diameter, sensing area. This FSR will vary its resistance depending on how much pressure is being applied to the sensing area. The harder the force, the lower the resistance. When no pressure is being applied to the FSR its resistance will be larger than 1MΩ. This FSR can sense applied force anywhere in the range of 100g-10kg.

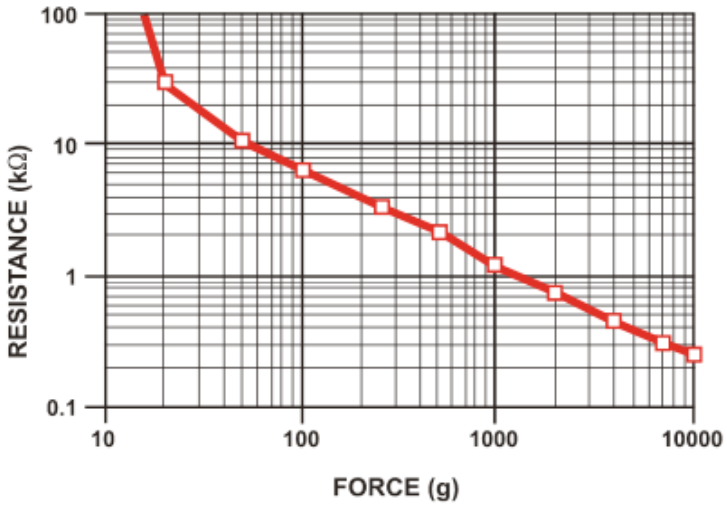


Figure 2: Resistance vs. Force

Internet of Things

Sensors : Force sensitive resistor

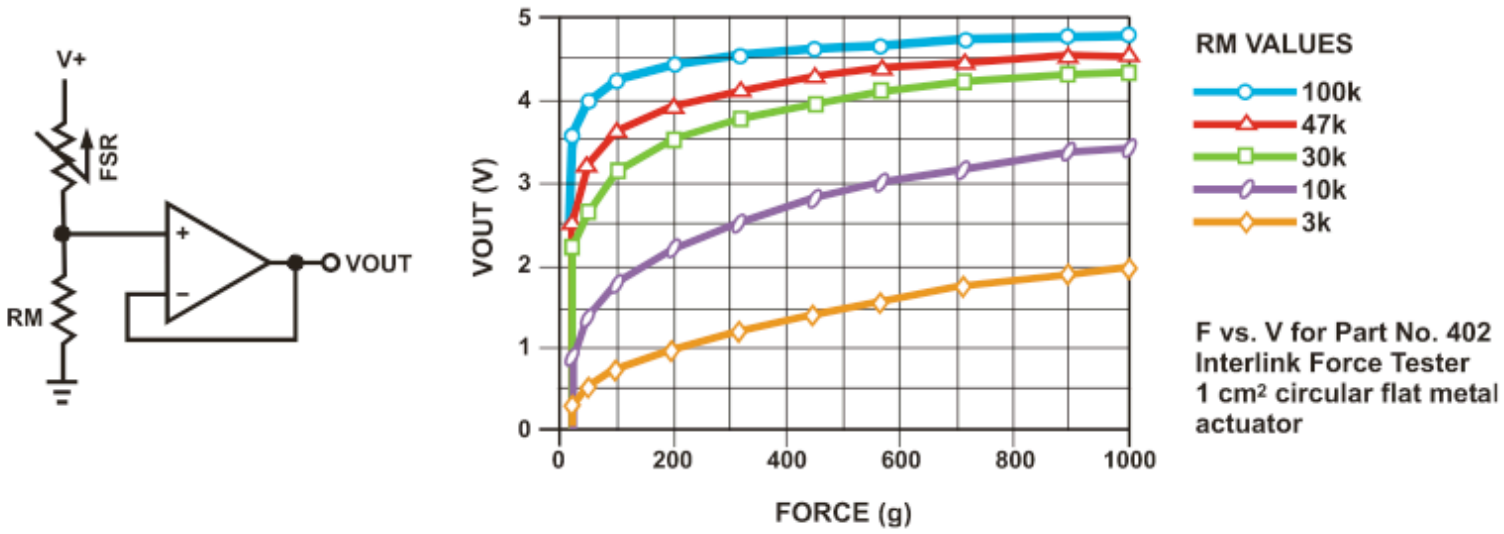


Figure 9
FSR Voltage Divider

Internet of Things

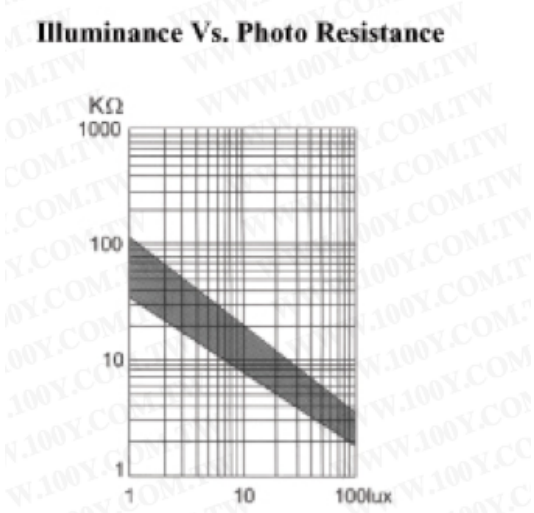
Sensors : Photocell

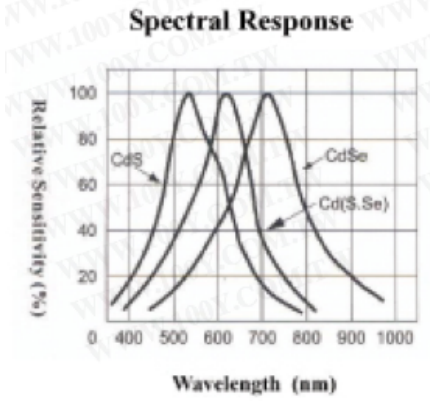
Description

Small photocell. A photocell changes resistance depending on the amount of light it is exposed to.

Features

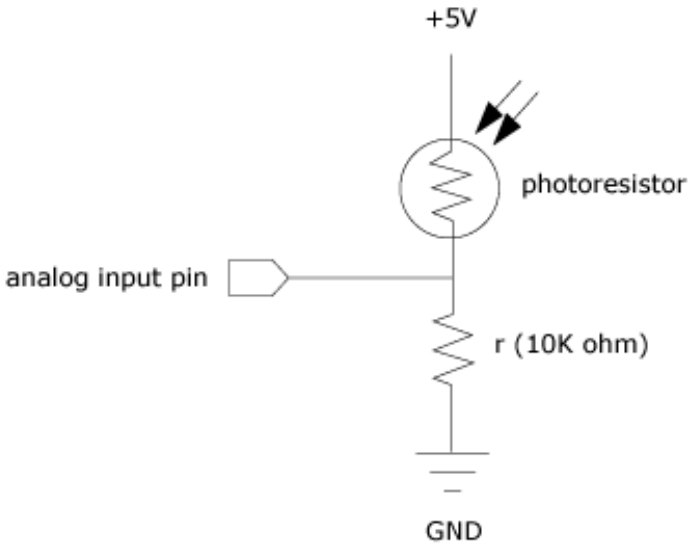
* Light resistance : ~1k Ohm
* Dark resistance : ~10k Ohm
* Max voltage : 150V
* Max power: 100mW

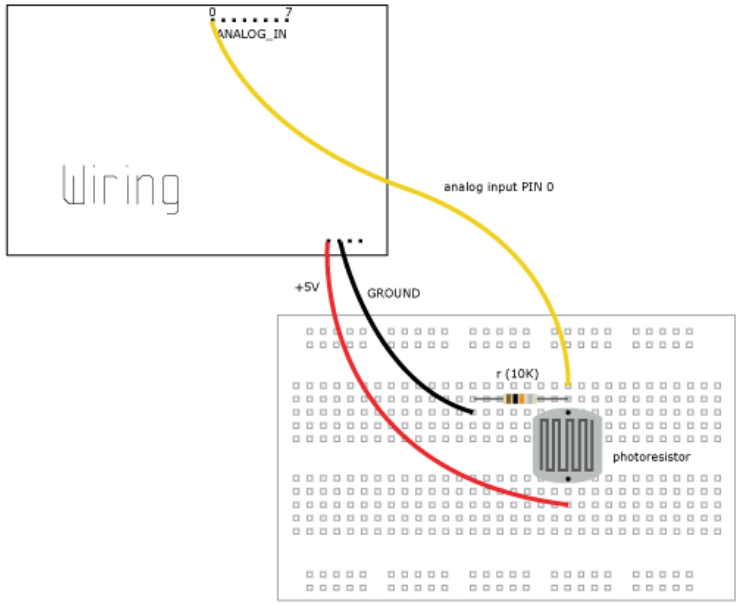




Internet of Things

Sensors : Photocell





From: http://www.wiring.org.co

Internet of Things

Sensors : Potentiometer

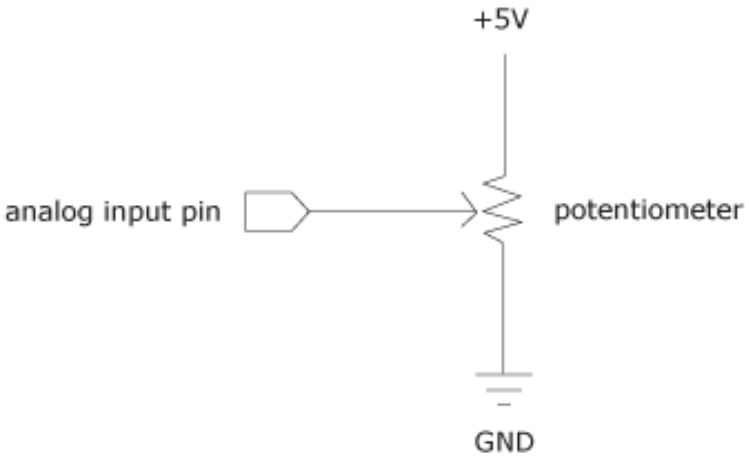
Description

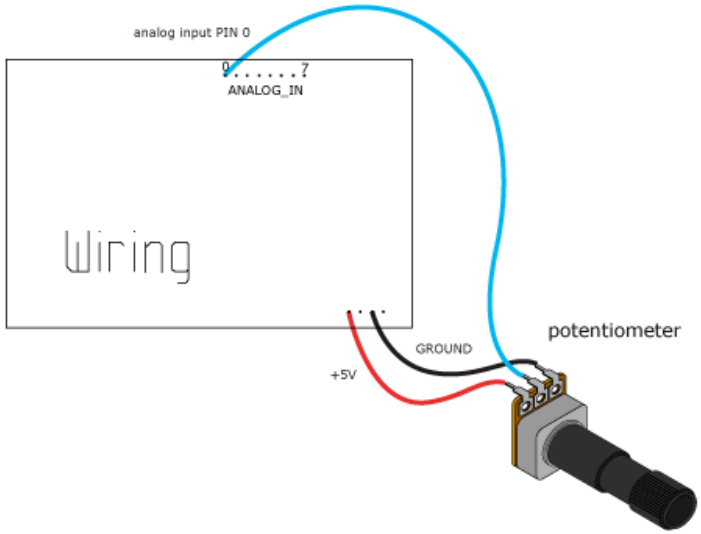
Adjustable potentiometer. Turn the pot and the resistance changes. Connect VCC to an outer pin, GND to the other, and the center pin will have a voltage that varies from 0 to VCC depending on the rotation of the pot. Hook the center pin to an ADC on a microcontroller and get a variable input from the user!

This is a center-tap linear type potentiometer. The outer two pins will always show 10K resistance, the center pin resistance to one of the outer pins will vary from 10K Ohm to about 50 Ohm. The pot is linear meaning the resistance will vary linearly with its position.

Internet of Things

Sensors : Potentiometer





From: http://www.wiring.org.co

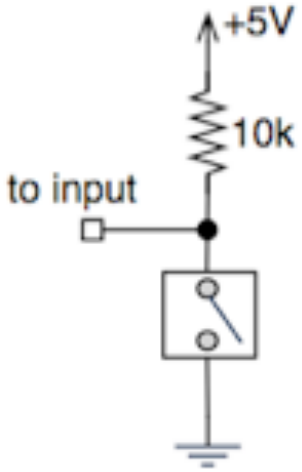
Internet of Things

Sensors : push button

Description

Square momentary button.

Large button head and good tactile feel.



ACTIONNEURS utilisés dans ce TP

> LED rouge
> LED tricolore
> Buzzer (vibartion et son)
> (écran du PC)
> (enceintes du PC)
> moteur

Internet of Things

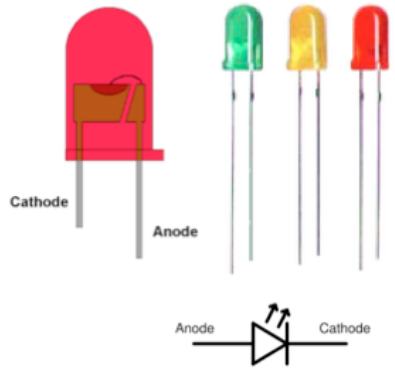
Single color LED

Description

Standard red LED. The lens is 3mm in diameter, and is diffused.
La diode Èlectroluminescente (LED) émet de la lumière. Elle est polarisé: la patte « + »est la plus longue, l'autre patte est la patte « - » La courte est connecté avec la terre.

Features

* 1.8-2.2VDC forward drop
* Max current: 20mA
* Suggested using current: 16-18m
* Luminous Intensity: 150-200mcd

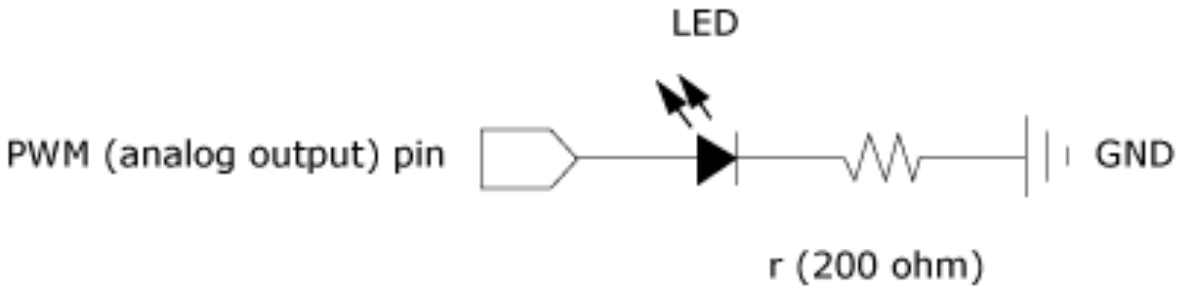


Absolute Maximum Ratings: (Ta=25℃) .

ITEMS	Symbol	Absolute Maximum Rating	Unit
Forward Current	I_F	20	mA
Peak Forward Current	I_{FP}	30	mA
Suggestion Using Current	I_{SU}	16-18	mA
Reverse Voltage (V_R=5V)	I_R	10	uA
Power Dissipation	P_D	105	mW
Operation Temperature	T_{OPR}	-40 ~ 85	℃
Storage Temperature	T_{STG}	-40 ~ 100	℃
Lead Soldering Temperature	T_{SOL}	Max. 260℃ for 3 Sec. Max. (3mm from the base of the expoxy bulb)	

Internet of Things

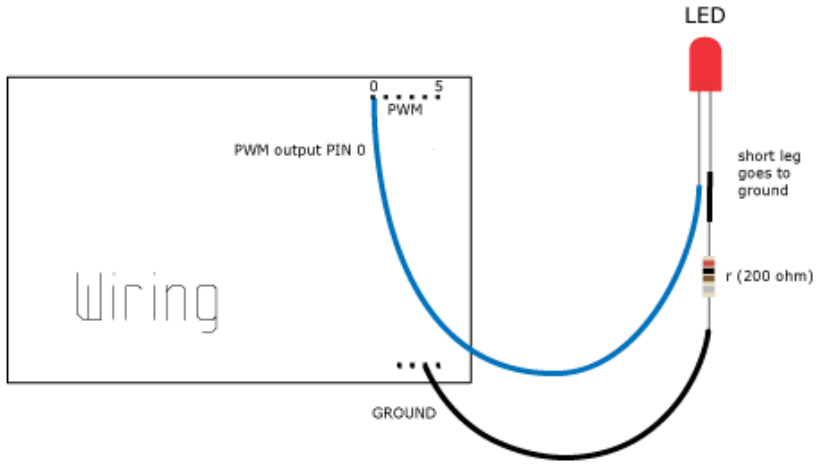
Actuator : single color LED



Arduino output voltage :

I/O pins : 5V max

Regulated outputs 3.3V and 5V



Arduino output current :

> 40mA (I/O pins)

> 200mA on VCC-GND, 5V

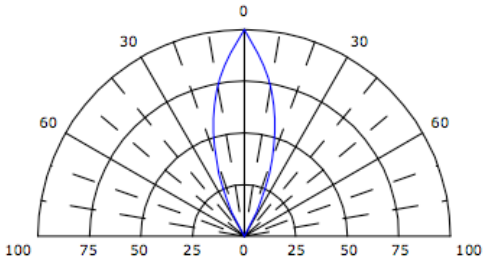
> 50mA on VCC-GND, 3.3V

Internet of Things

Actuators : RGB LED

Description

RGB LED. Red, Green, Blue. four pins - Cathode is the longest pin (!).
One for each color and a common cathode. Use this one LED for three status indicators or pulse width modulate all three and get mixed colors!

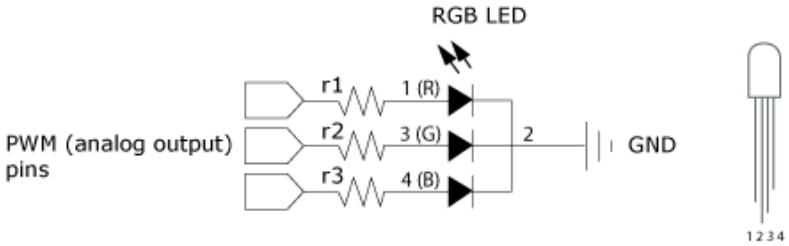


LED Chip Typical Electircal & Optical Characteristics: (Ta=25℃)

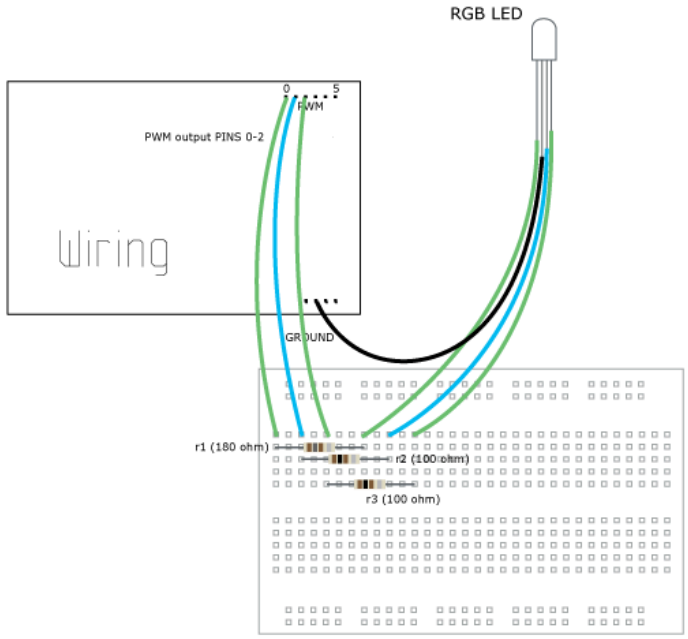
ITEMS	Color	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Voltage	Red	V_F	I_F=20mA	1.8	2.0	2.2	V
	Green			3.0	3.2	3.4	
	Blue			3.0	3.2	3.4	
Luminous Intensity	Red	I_V	I_F=20mA	– – –	– – –	800	mcd
	Green			– – –	– – –	4000	
	Blue			– – –	– – –	900	
Wavelenength	Red	Δ λ	I_F=20mA	620	623	625	nm
	Green			515	517.5	520	
	Blue			465	466	467.5	
Light Degradation after 1000 hours	Red	-4.68% ~ -8.27%					
	Green	-11.37% ~ -15.30%					
	Blue	-8.23% ~ -16.81%					

Internet of Things

Actuators : RGB LED



r1 (180 ohm)
r2 (100 ohm)
r3 (100 ohm)



Internet of Things

Actuators : Buzzer

Description

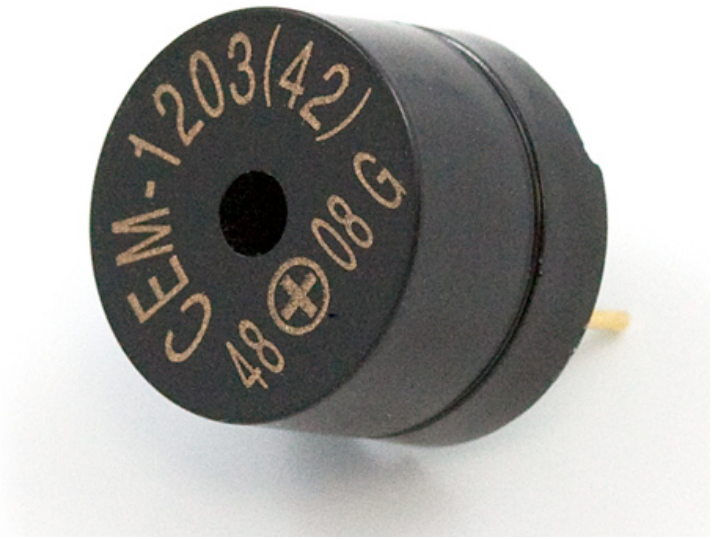
Round buzzer that operates around the audible 2kHz range.

Can be driven directly from a 5V PIC to generate a tone.

Use this buzzer to create simple music or user interfaces.

SPECIFICATION

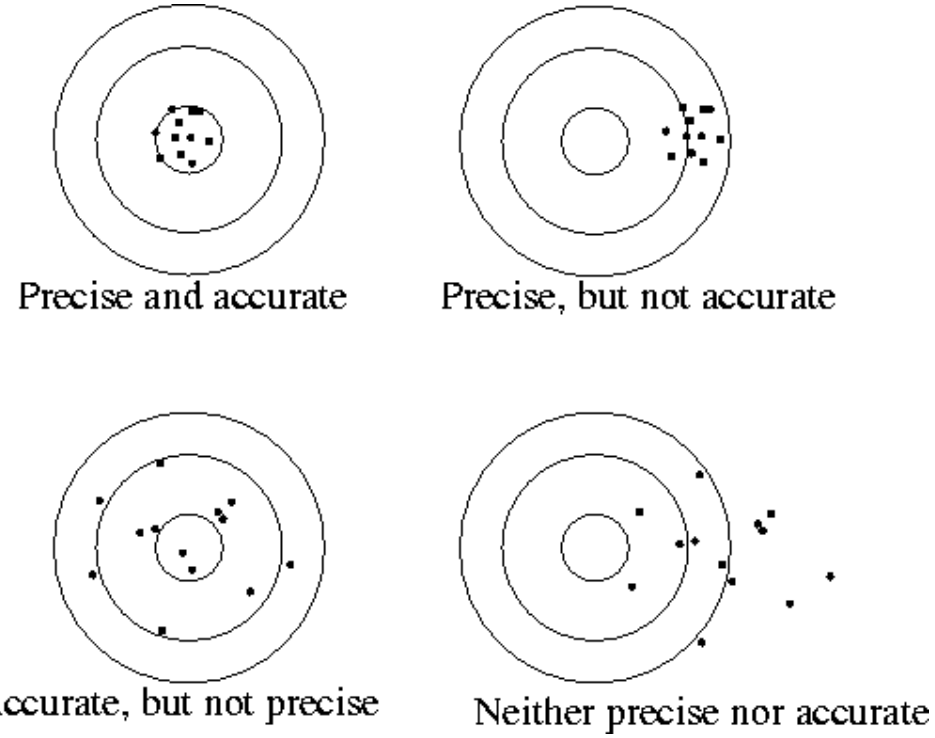
No.	Item	Unit	Specification	Condition
1	Rated Voltage	Vo-p	3.5	Vo-p  0V
2	Operating Volt.	Vo-p	3.0~5.0	
3	Mean Current	mA	Max. 35	Applying rated voltage,2048Hz square wave, 1/2duty
4	Coil Resistance	Ω	42.0 ± 6.3	
5	Sound Output	dBA	Min.85 (Typical 95)	Distance at 10cm(A-weight free air). Applying rated voltage 2048Hz,square wave, 1/2duty
6	Rated Frequency	Hz	2048	
7	Operating Temp.	℃	-20 ~ +60	
8	Storage Temp.	℃	-30 ~ +70	
9	Dimension	mm	ϕ12.0 × H8.5	See attached drawing.
10	Weight	gram	1.4	
11	Material		PPO(Black)	
12	Terminal		Pin type (Plating Au)	See attached drawing.
13	Environmental Protection Regulation		RoHS	



Internet of Things

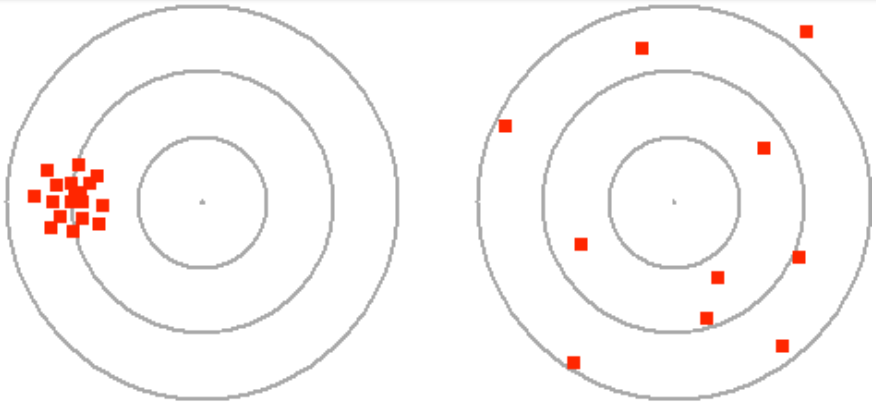
Precision and accuracy

Measurement error : Precision and Accuracy
Precision : repeatability, noise, random error (fidélité)
Accuracy : systematic errors (justesse)



Internet of Things

Random errors, systematic errors



Random error

→ make multiple measurements (precision is reduced by 1/sqrt(n)).

→ can be completely reduced to 0 (if you have enough time for the measurement)

Systematic error

→ find the source, incorporate into the mathematical model

→ source might be difficult to find and to quantify (humidity impact, temporal drifts, …)

→ are more annoying than random errors, frequent recalibration

IoT, digitize & connect

DATA UP
CLOAD
DATA DOWN

UP : quantification, digitalization & upload
CLOAD : data aggregation, big data, data fusion, data correlation, data analysis, data treatment, data mining, data extraction
DOWN : download & data materialization

Combing **Internet of Things & Cloud**
Combing **social collaboration & scientific treatment**

→ *Largest power system ever built*
→ *By far the biggest societal challenge in the next decades*

IoT

1. Permanent Individual Planetary Reach

> Access to knowledge
> Access to expertise
> Access to remote actions

2. The Graal of the Communicator

you are permanently in the pockets of everyone
→ The right message, to right person, at the right time

3. Efficiency Boost

Live and global data about supply and demand allows much more efficient resources allocation, waste reduction and the Long Tail effect

IOT : Connected Cloud, UP

POWER OF KNOWLEDGE

> Digitalization of societies documents, books, articles, news

> Digitalization of the users personal news, reflections, interests, actions, bank account movements, internet searches, relationships,..

POWER OF STATISTICS

> Quantification of context : user localization, surrounding temperature, user mood, user body temperature, insulin level,…

> Quantification of the state of the planet : temperature map, webcams, satellite IR measurement, bees population, extracted minerals maps, energy ressources distribution

POWER OF COLLABORATION

> Connection of friends, groups and peers, crowd sourcing, sharing economy

> Connection of human expertise

(needs sensors, wireless internet connection, power autonomy**, user trust**)

Connected Cloud

CLOAD

USER AWARENESS

User context awareness (near metro station, raining, near friends,…)
User profile awareness (user interests, agenda, vegetarian, clothing style,…)
User situation awareness (on holliday, with family at home, bad mood, searching a new car, just got up,…)

PLANET AWARENESS

Current situation (storms approaching, imminent resource shortage, financial crash,…)
Planet history (global weather changing, epidemics patterns, wealth distribution, animal extinction,…)

(needs fast data access, fast data treatment, common data ontology, semantic interpretation)

Connected Cloud

DOWN

IMMERSION
> User Transportation : Complete feeling of being in a different situation

UX : User Experience
> Data materialization adapted to users situation
Situation Awareness, Context awareness. Profile Awareness
Actuator technology : Seamless? Discreet? Urgency? Tactile? Fragrances?

(needs actuators, wearables, affective computing**, people first**)

Connected Cloud, Advantages

Empowerment of every single person → more democratic, less elitist

Cut out the intermediaries → faster, cheaper

Planetary competition → better, cheaper

Actions of every person recorded → Higher security, better health, fairer treatment, reduced society costs

Trust by ratings → less corrupt, cheaper

Connected Cloud, dangers

Skewed data algorithms
Big players adapt the selection algorithms to their advantage (only 6% of users go to second page) → corruption, more expensive

Increased Power Concentration
Winner takes all through viral effects → corruption, more expensive

Big Brother, permanent surveillance → reduced liberty
(by peers, state, large companies)

Systemic Living
Algorithms decide our actions. No surprises, no boring times → lobotomized happy citizens

Internet of Things

Overview Session Project

Projet

> Réalisation d'un IoT "development durable" / "écologique"
> Travail en groupe
> Version idéale
> Prototype

2 parties

> Reflexion IoT
> Implémentation sur Arduino + Processing

Internet of Things

Notation du projet

Projet idéal

> Document pdf 1 page: type “fiche produit” avec nom (projet et des membres du groupe), slogan, illustrations et fonctionnement.
> IoT : partie internet doit être indispensable
> Description de la cible, **quantification** de son effet.

Critères:

> Pertinence par son possible impact
> Innovation
> Cohérence du projet (UX, graphique, fonctionnalités, groupe cible)

➢ Présentation et message marketing/ communication

Internet of Things

Notation du projet

Prototype

> Prototype qui fonctionne

> Présentation du prototype, des pistes techniques essayées mais abandonnées, techniques intégrés (schéma électronique / libraires utilisées /…)

Critères:

> Complexité des fonctionnalités intégrés

> Nombre d'étudiants dans le groupe

> Présentation et réponse aux questions

Internet of Things
Connexion web

Séance Procesisng / internet

- Arduino et Processing
- Exercices prototypage : Arduino et connexion web

Internet of Things

CX Internet

fonctionnalités internet

> Multi – joueur
> (connecté à votre chat)
> Game analytics
> High score
> News-feed
> Flux RSS (taux de bourse, news,…)
> Météo distante
> Envoi SMS
> Email (envoie, check inbox, check contenu,…)
> Profil d'une personne
> Résaux sociaux : FB, Twitter, PInterest,..
> Position d'une personne ou d'un objet
> Activité d'une personne
> Connexion vers un autre objet communicant
> Agrégation et traitement et visualisation de données
> Stockage de données
> Processuers performantes

Internet of Things

Atelier IoT

Capteur

> Thermistor
> Capteur de flexion
> Capteur de force
> Capteur de lumière
> Capteur de distance
> Capteur Tilt
> Capteur d'acceleration
> Capteur de mouvement
> Gyroscope
> RFID / NFC
> Capteur rythme cardiaque
> Capteur de touche
> Capteur de son
> Humidité
> Niveau d'eau

Actionneur

> LED tricolore
> Buzzer
> Ventilateur
> Matrice LED (grand / petit)
> Relay
> Moteur
> écran du PC
> enceintes du PC
> Laser
> Diode IR

CX

> GPRS
> 433MHz receiver emitter

Pertinence
Simplicité
Cohérence