Arduino
an Introduction

Sebastian Büttrich
(with input from Aurelien Tabard and others at ITU & other places)

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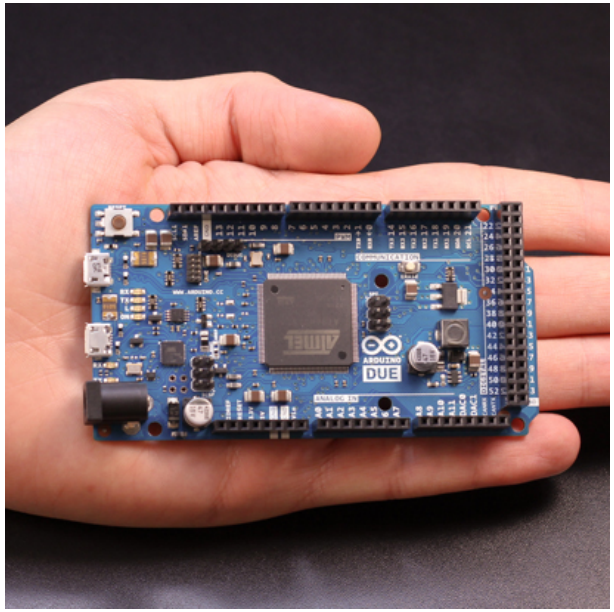
IT UNIVERSITY OF COPENHAGEN

PIT LAB

What is Arduino?

Arduino is an
open-source
electronics prototyping platform

based on flexible,
easy-to-use
hardware and software.



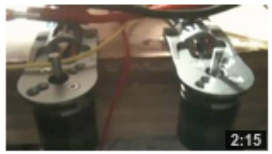
It's intended for
artists, designers, hobbyists,
and anyone interested
in creating interactive objects or environments.

http://arduino.cc/

Who makes Arduino?

ShapeOko: NES + Arduino + 3 Axis Mill = Awesome!
by **Edward Ford** · 3 years ago · 13,601 views
Using a classic NES controller to manipulate the X,Y, and Z axis' of my DIY CNC
HD

Working pipboy 3000
by **MyMagicPudding** · 1 year ago · 1,102,997 views
Update: Tutorial: http://mymagicpudding.blogspot.co.uk/2013/02/making-pipboy-
HD



Arduino Quadcopter Progress 1
by **GamecubePerson111** · 7 months ago · 181 views
Arduino powered Quadcopter test.

30 Arduino Projects for the Evil Genius
by **Simon Monk** · 2 years ago · 314,296 views
This is an introduction to the book '30 **Arduino** Projects for the Evil Genius' by

Awesome Arduino Robot Avoiding Walls
by AweseomePossumCraft · 1 month ago · 69 views
Using the Four Wheel Platform, an **Arduino** with an Adafruit AFMotor Shield and a
HD

The **Arduino team** is:
Massimo Banzi,
David Cuartielles,
Tom Igoe,
Gianluca Martino,
and David Mellis.

It is carried by a huge crowd of enthusiast developers -

Anything you might need has probably already been tried and documented somewhere!
Just try: https://duckduckgo.com/?q=arduino

Why Arduino?

Arduino is

- Inexpensive
- Quite easy to learn
- Flexible
- Low power
- Good for sensing and controlling
- Great for use in education

Why Arduino for WSN?

Today, many WSN systems are expensive and not transparent to their users.

Arduino offers a great chance to make WSN

more affordable

more open

As Arduino is a prototyping and experimenting platform, it will **not be optimal for every aspect** - but, once a good solution has been found, it may become a new Arduino-type hardware design, optimized for the given task.

Tech details - software

The software consists of a standard programming language compiler and a boot loader that executes on the microcontroller.

The programming language is based on ***wiring***,

And in terms of syntax (almost) identical to C++.

The development environment is based on ***processing*** -

both ***wiring*** and ***processing*** are open source components.

Those familiar with C/C++ will find many similarities.

Tech details - software

Arduino/Processing Language Comparison

The Arduino language (based on Wiring) is implemented in C/C++, and therefore has some differences from the Processing language, which is based on Java.

Arrays

Arduino	*Processing*
int bar[8]; bar[0] = 1;	int[] bar = new int[8]; bar[0] = 1;
int foo[] = { 0, 1, 2 };	int foo[] = { 0, 1, 2 }; *or* int[] foo = { 0, 1, 2 };

Loops

Arduino	*Processing*
int i; for (i = 0; i < 5; i++) { ... }	for (int i = 0; i < 5; i++) { ... }

Printing

Arduino	*Processing*
Serial.println("hello world");	println("hello world");
int i = 5; Serial.println(i);	int i = 5; println(i);
int i = 5; Serial.print("i = "); Serial.print(i); Serial.println();	int i = 5; println("i = " + i);

Tech details - software

The arduino language has 3 main elements:

Structure, Variables, Functions.

Structure

The most important two parts of any Arduino program:

setup() *executed once in the start*

loop() *executed repeatedly (looped)*

Tech details - software

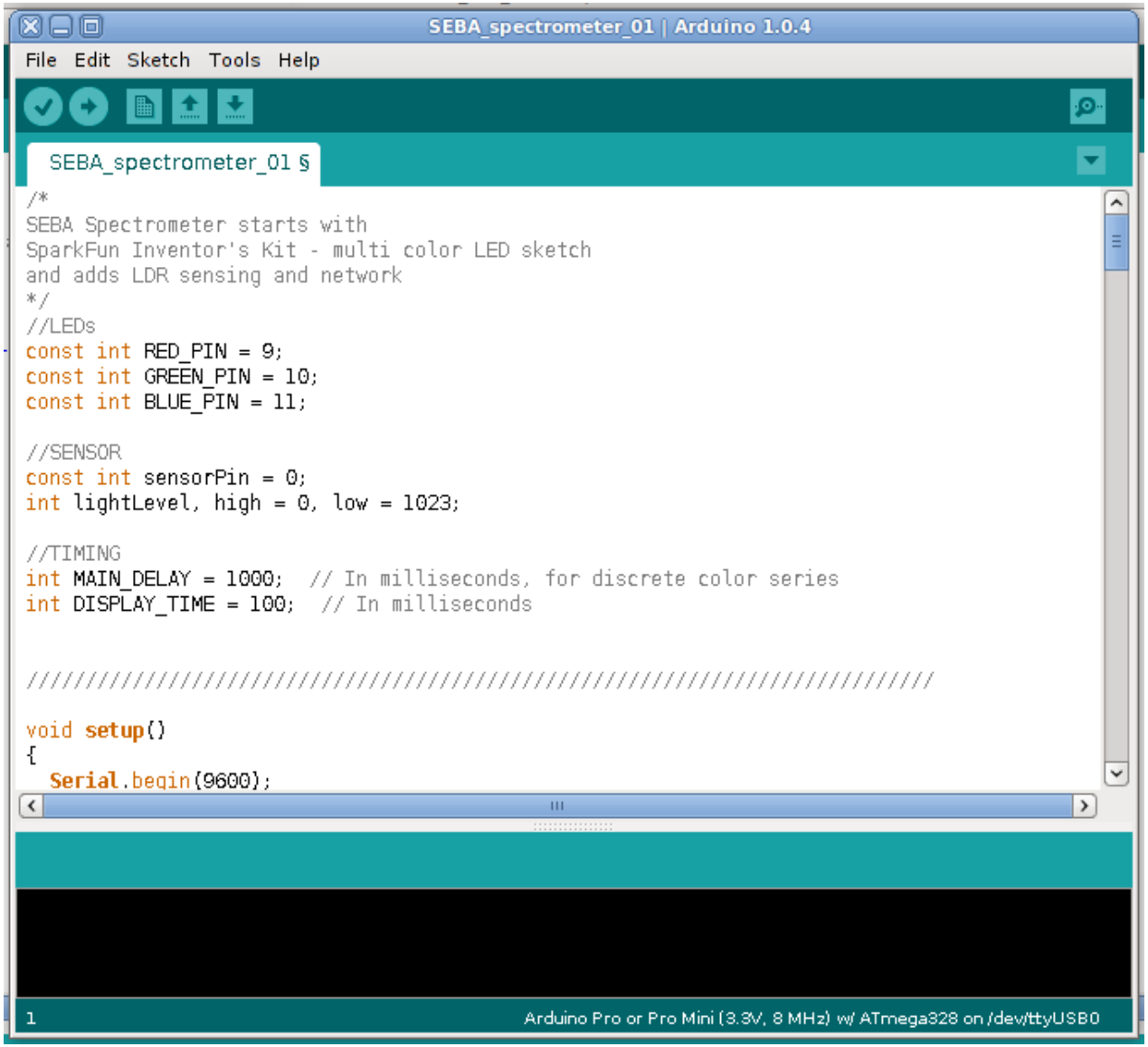
The language offers the familiar set of **operators, variables, functions.**

An important concept is the use of **libraries.**

For a full description of the language, see

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

Tech details - IDE



Tech details - hardware

Arduino boards are based around

Atmel processors (ATM168, ATM328).

The main board can be extended by a wide offering of so-called shields, for example

- Network shields

  for all kinds of wireless and wired communications,

- Sensor shields for hundreds of sensing applications.

Tech details - hardware

Typical boards:

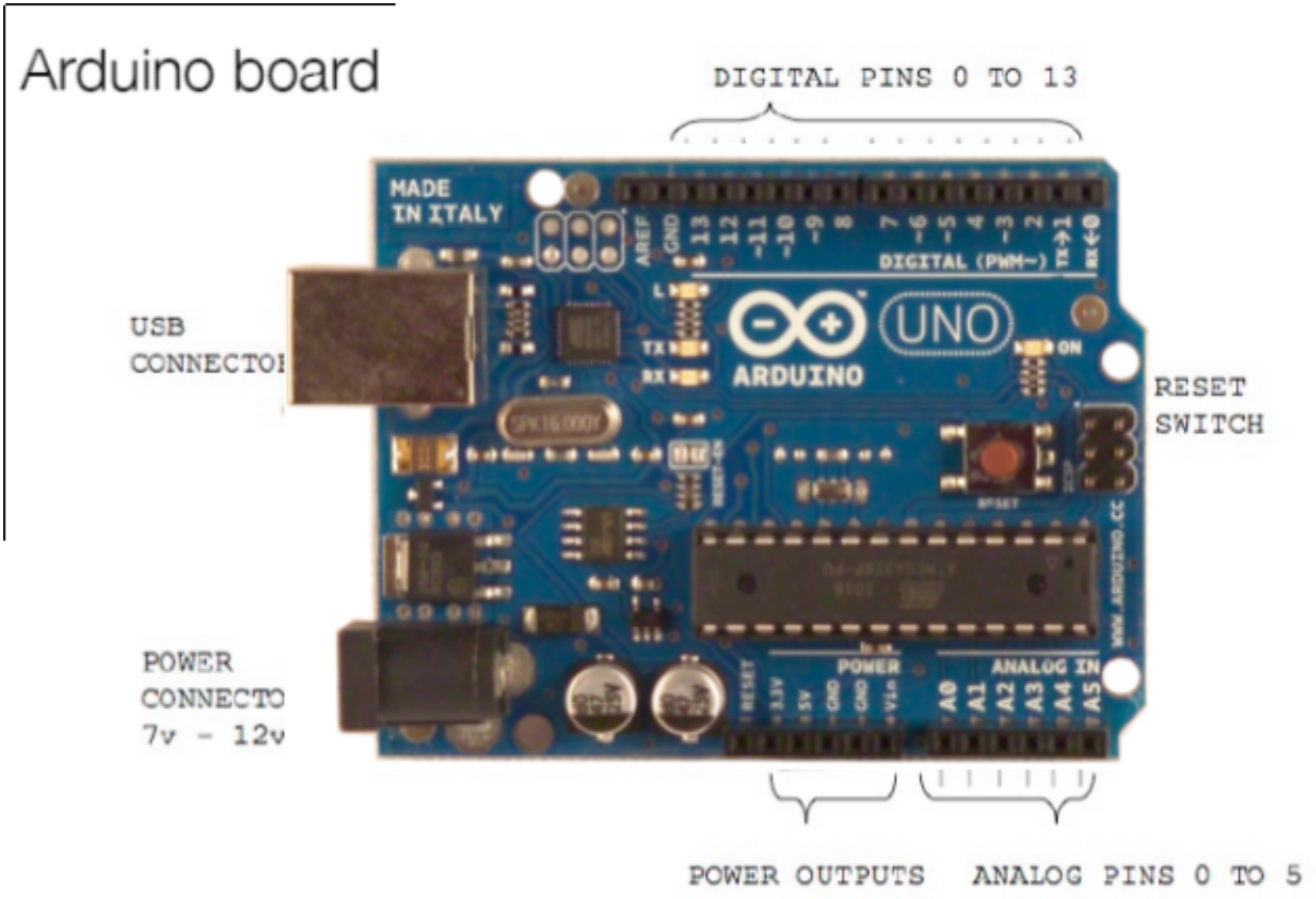
8 bit controllers (new DUE board is first with 32 bit)

16 / 8 Mhz

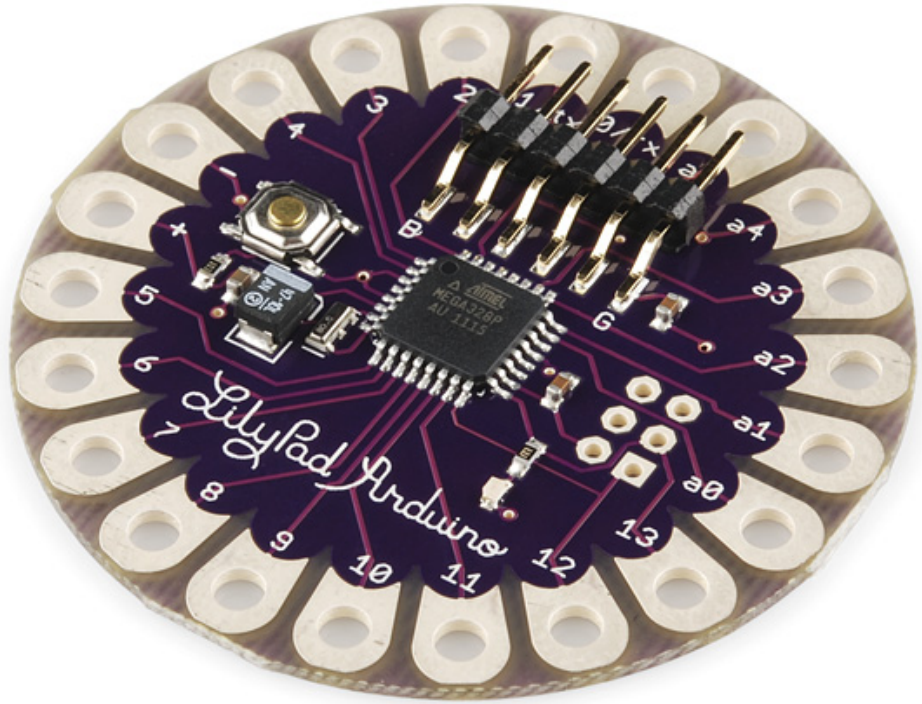
Approx. 32k of memory for code

Run on 3.3, 5 (and up) Volts

An Arduino board



Arduino boards in many forms



Arduino boards in many forms

Arduino Uno

Arduino Leonardo

Arduino Due

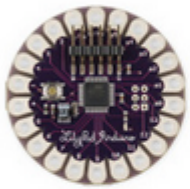
Arduino Esplora

Arduino Mega 2560

Arduino Mega ADK

Arduino Ethernet

Arduino Mini

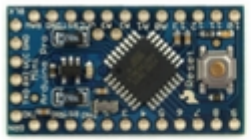


LilyPad Arduino

LilyPad Arduino USB

Arduino Micro

Arduino Nano

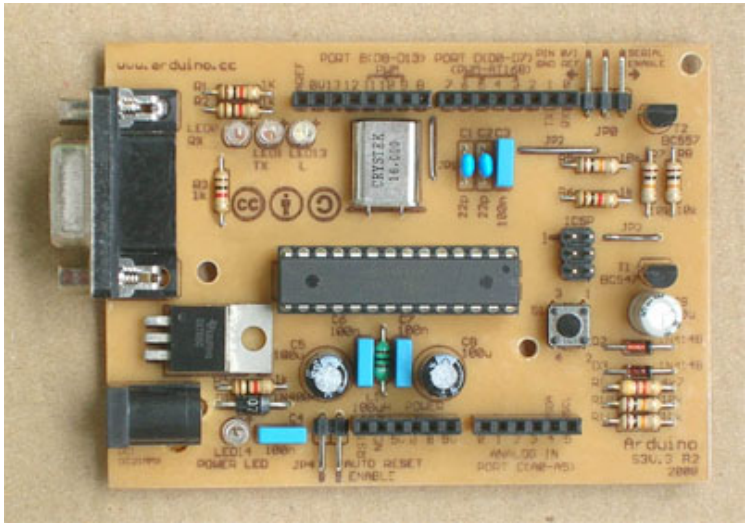


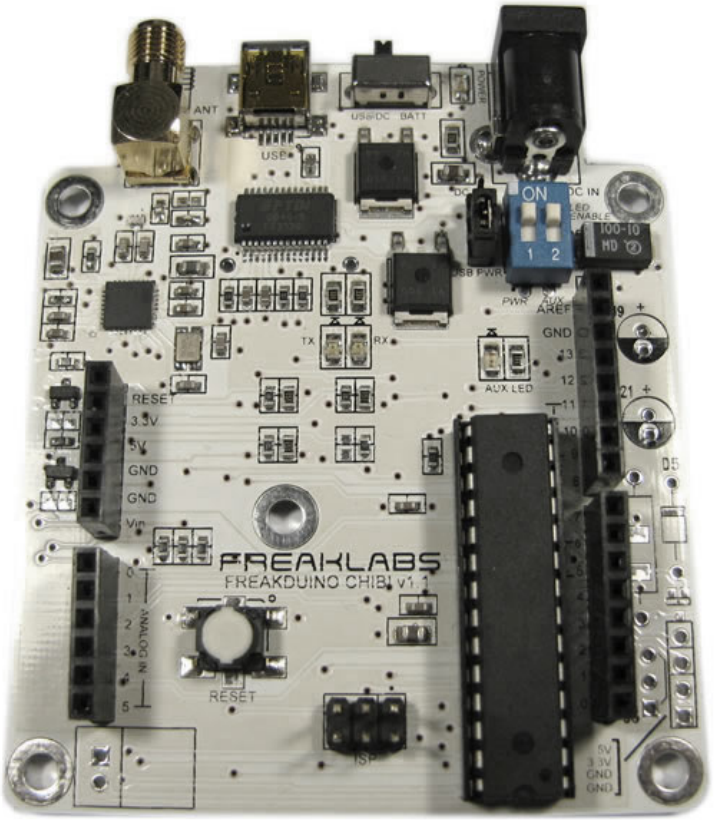
Arduino Pro Mini

Arduino Pro

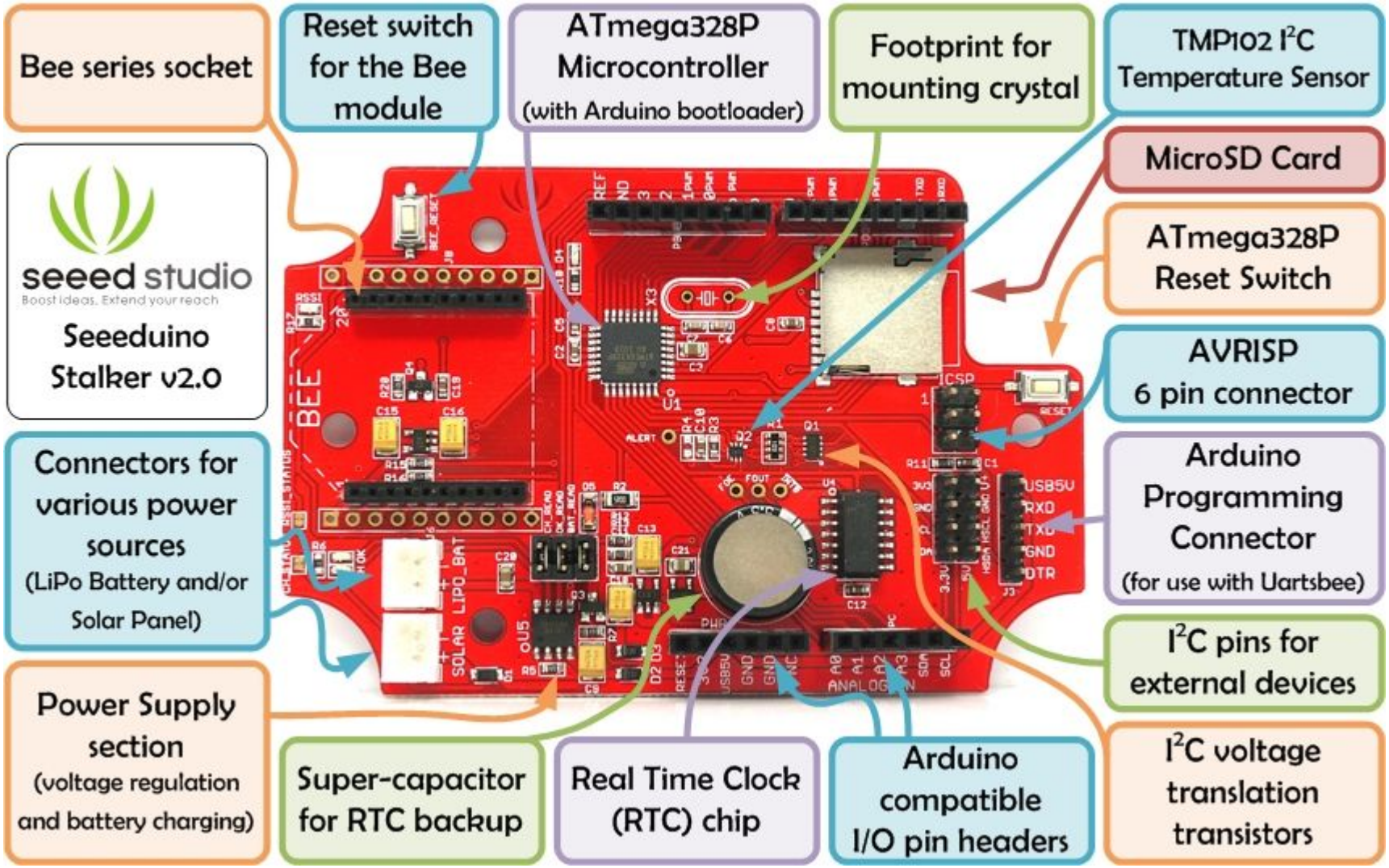
Arduino Fio

Arduino boards in many forms



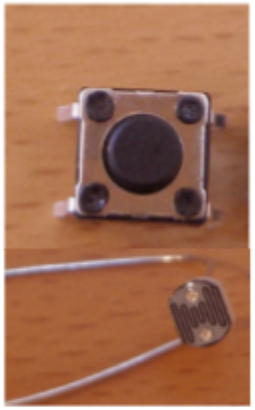


Arduino boards: Seeeduino



Arduino - sensors

Sensors



button

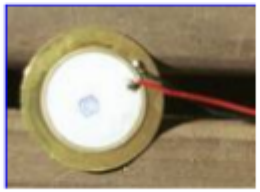
light sensor

heat sensor

RFID reader

proximity sensor

accelerometer



piezo/ pressure sensor

flex sensor

Arduino - sensors

We keep a little list at: http://pitlab.itu.dk/content/sensors

Arduino and similar platforms are a relevant choice for prototyping and deploying sensors and (wireless or wired) sensor networks. As an inspiration, not as a complete list, here are some suggestions for how one would measure ...

1.1 ... Air pollution

http://www.satistronics.com/air-quality-control-sensor-mq135_p2770.html

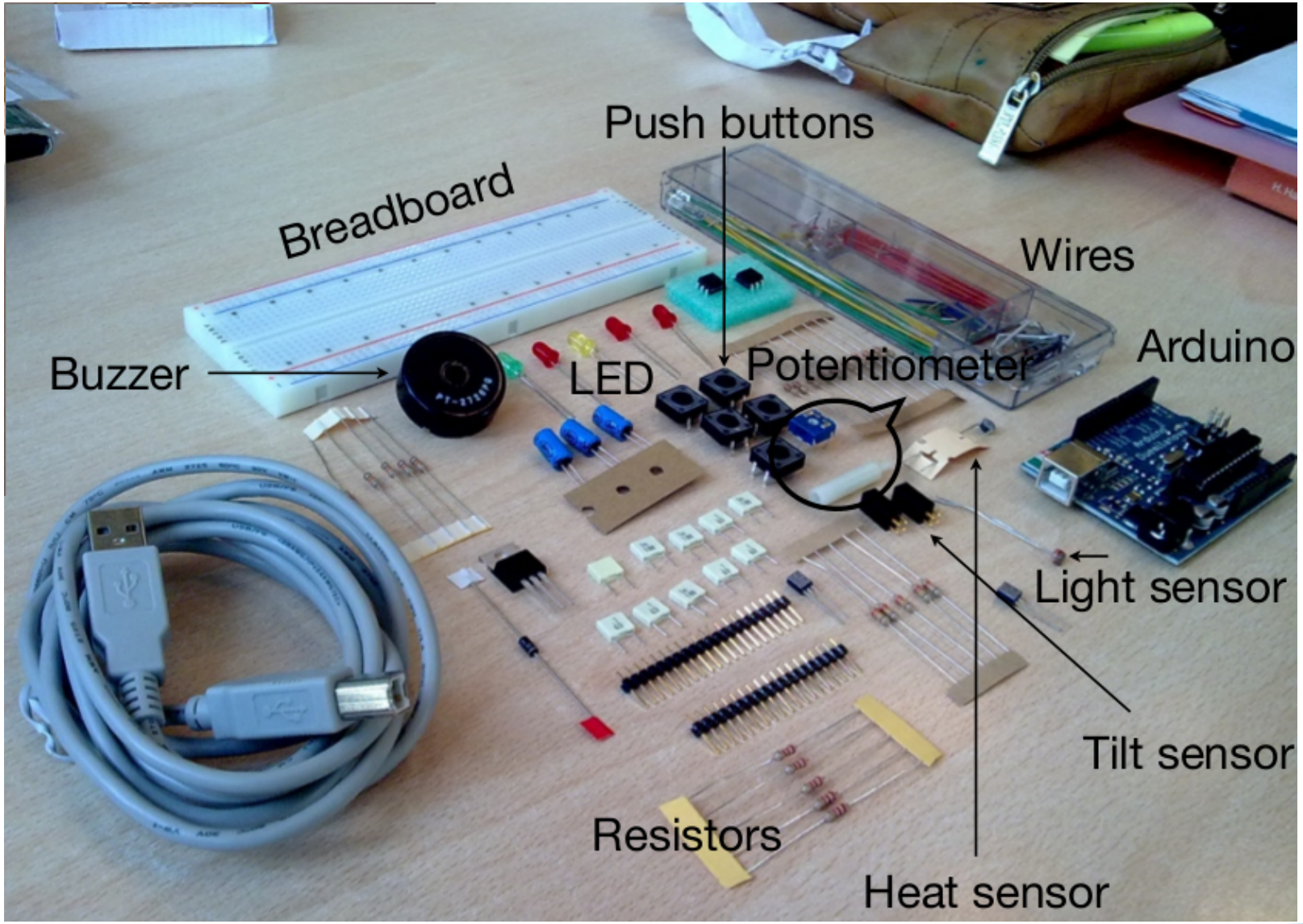
1.2 ... Current

Non-invasive, clip-on:
http://www.sparkfun.com/products/10341

1.3 ... Distance

MaxSonar Ultra Sonic Range finders
http://www.maxbotix.com/products.htm

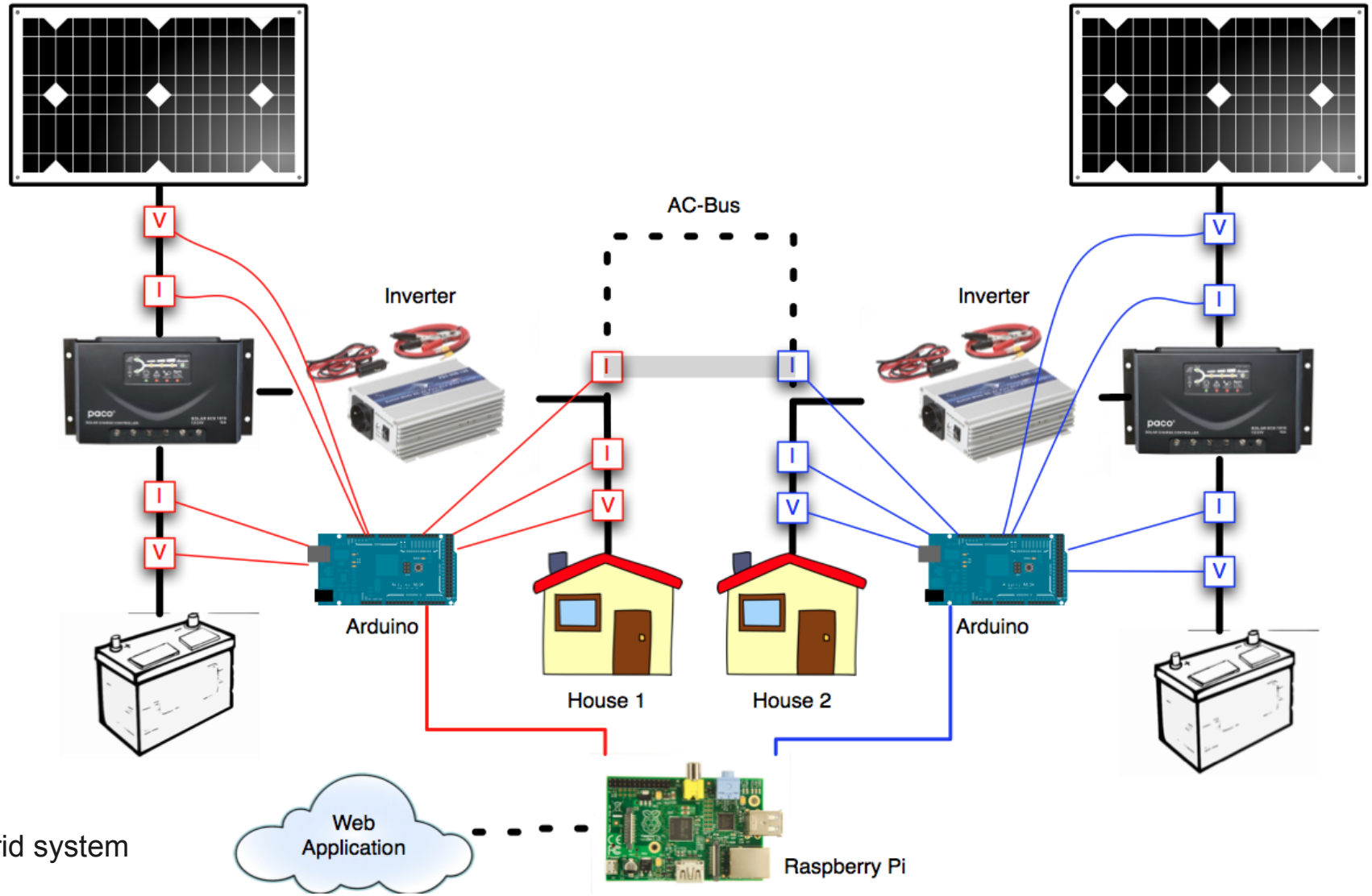
Arduino - kit


Push buttons
Breadboard
Wires
Buzzer
LED
Potentiometer
Arduino
Light sensor
Tilt sensor
Resistors
Heat sensor

Arducopter

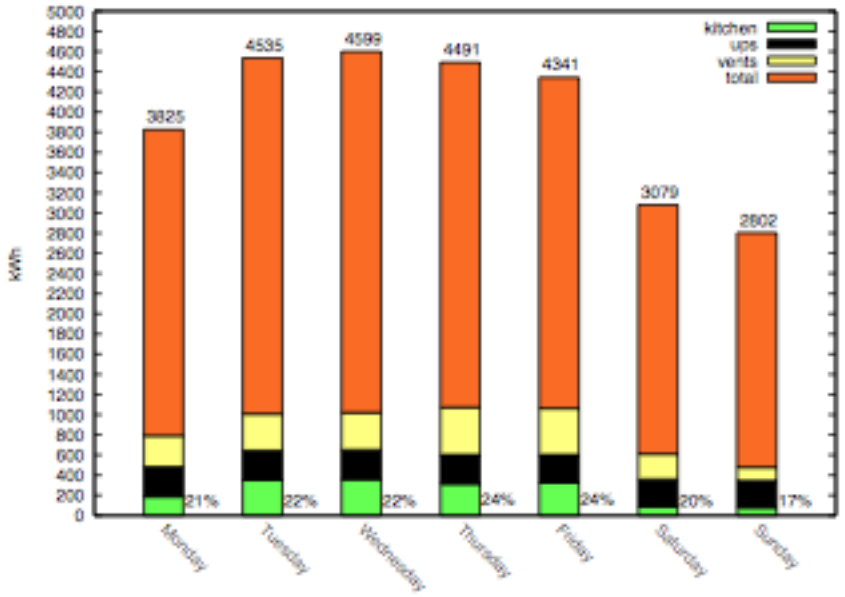

Crazyflie Nano Quadcopter
Weight: ~19 g
Size: 9 cm x 9 cm
Flight time: 7 min
Charge time: 20 min

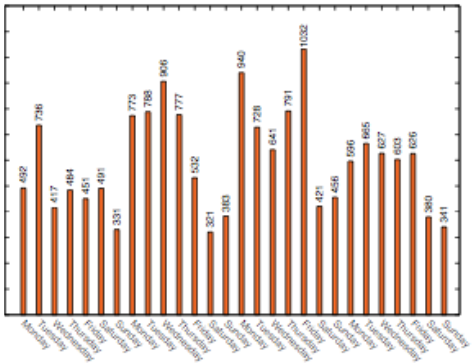
Arduino in solar energy

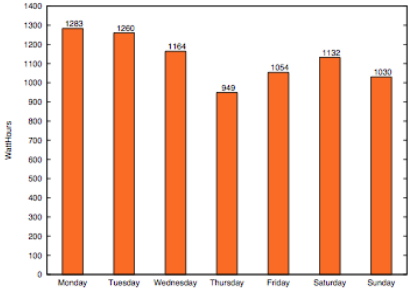


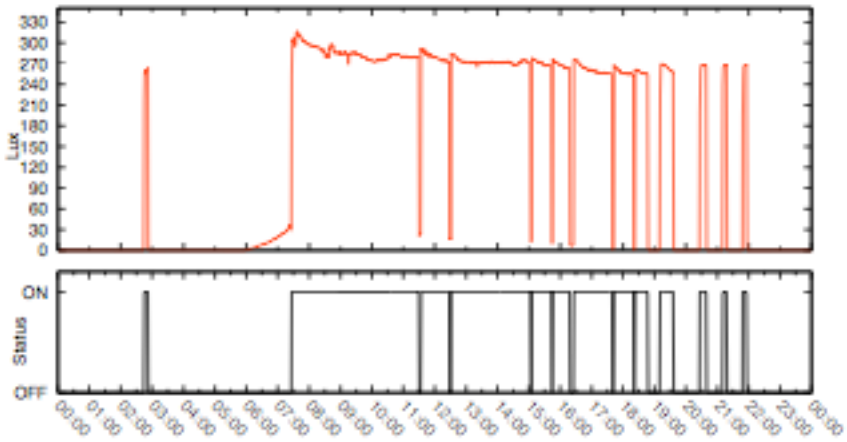
Micro grid system

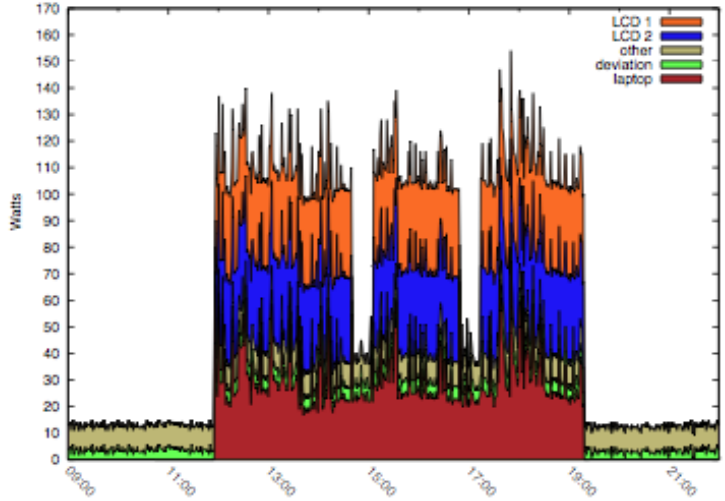
Building Instrumentation using Arduino elements



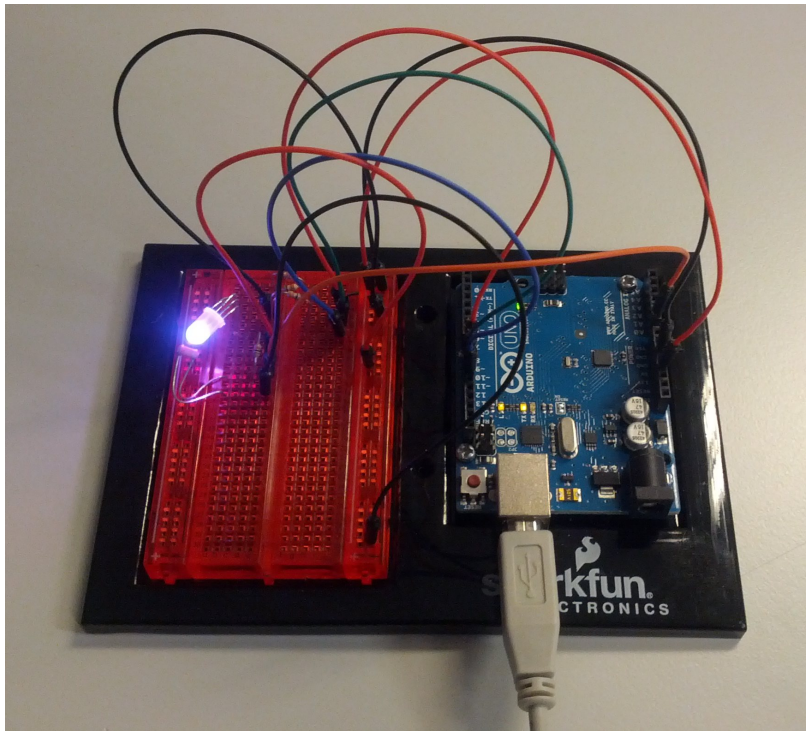


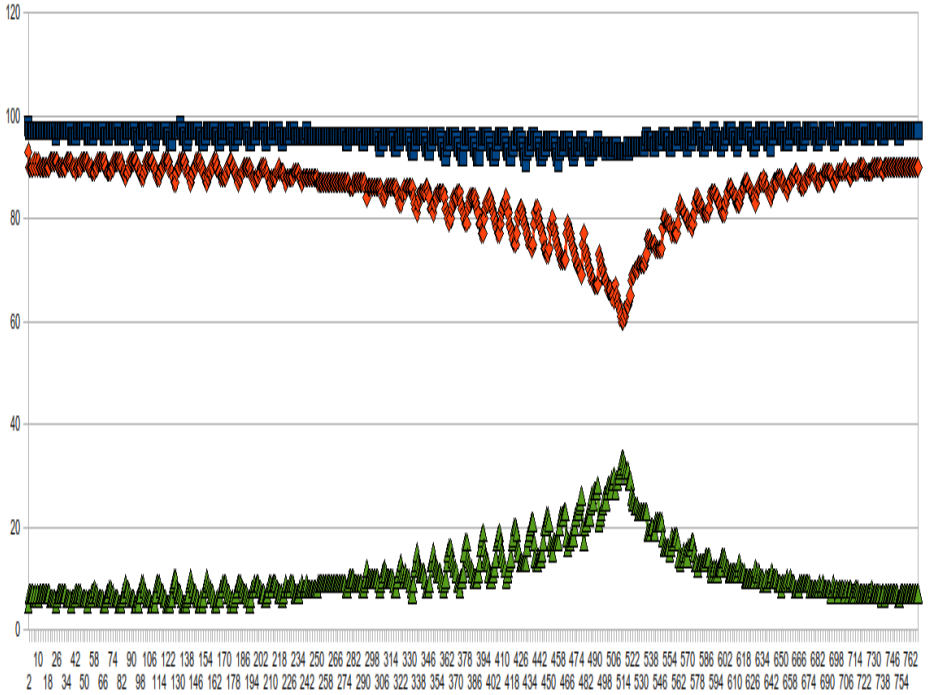






A rapid development “spectrometer”





Getting started and learning more

Start at the source: http://arduino.cc

Explore the Arduino community

There are great guides out there, e.g.
Sparkfun SIK Guide
https://www.sparkfun.com/products/11581

Try it ... **at the lab!**

And you are welcome to continue in the evening (and bring music)!