Arduino - an Introduction

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NSRC

based on courses given at ICTP Trieste & the IT University of Copenhagen
last edit: AIT Bangkok, December 2014

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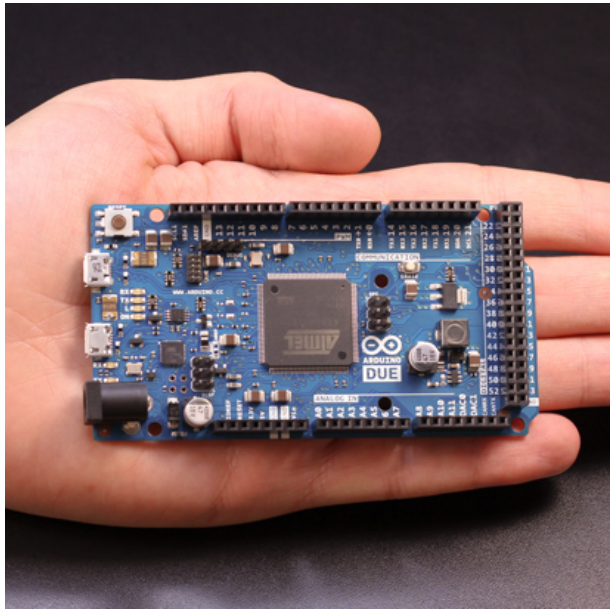
What is Arduino?

Arduino is an
open-source
electronics prototyping platform

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



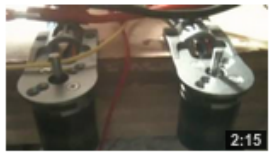
It's intended for
artists, designers, hobbyists,
and anyone interested
in creating interactive objects or environments.

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 global crowd of enthusiast developers.

By 2014, an estimated 1.5 million Arduinos have been sold.

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Arduino – Getting started

http://arduino.cc

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

Some good starting points are:
Sparkfun, Adafruit, Seeedstudio, Maker zines

Thailand sites/shops include:
http://www.arduino.in.th/
http://www.arduinothaishop.com/

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Arduino – Getting started

Sparkfun Inventors KIT (SIK)
& Guide
https://www.sparkfun.com/products/12060

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Arduino – Getting started

adafruit SHOP BLOG LEARN FORUMS VIDEOS

LEARN ARDUINO

Adafruit Arduino Selection Guide

Which Arduino is Right for Me?

Selecting an Arduino

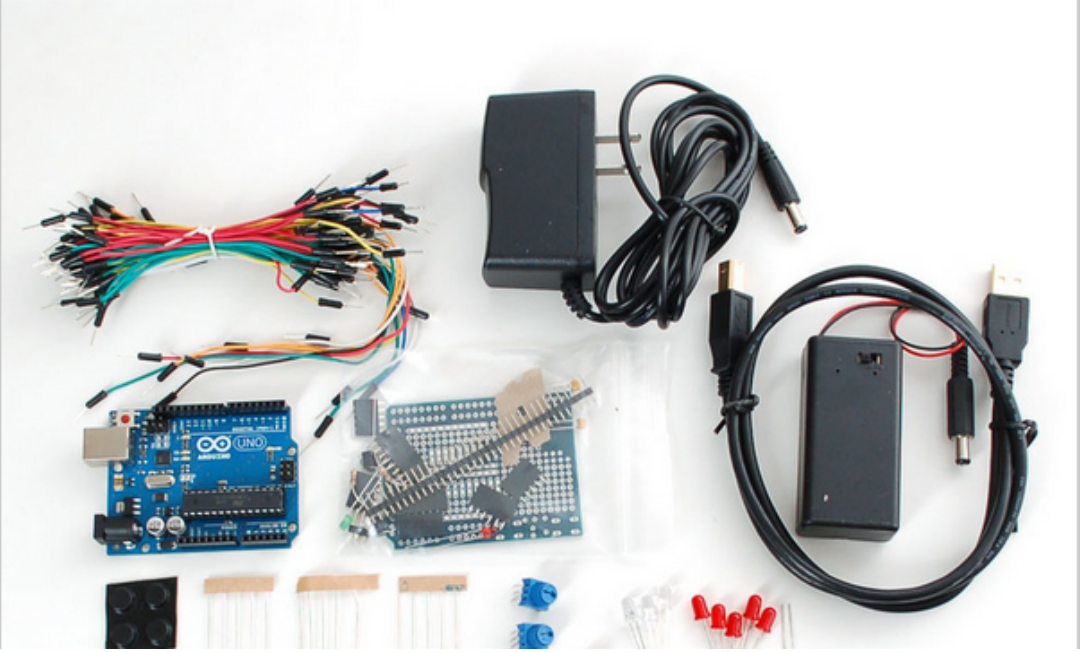
Getting Started

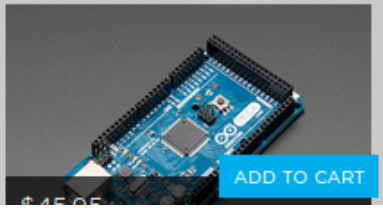
Bigger and Better Projects

Getting Started

BILL EARL

If you are just getting started with the Arduino, congratulations and welcome to the world of microcontrollers and electronics!





https://learn.adafruit.com/adafruit-arduino-selection-guide/selecting-an-arduino

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Why Arduino?

Arduino is

- Inexpensive (~ $20 for official, from ~$5 for copies)
- Quite easy to learn
- Flexible
- Low power
- Good for sensing and controlling
- Great for use in education

Application: 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 – programming Arduino

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***,

the development environment is based on ***processing*** - both ***wiring*** and ***processing*** are open source components.

Tech details – Arduino vs C/C++

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

In terms of syntax, Arduino is (almost) identical to C++. however, it only implements a *subset* of full C++,

It links against the hardware-specific AVR_Libc, and thus is not fully portable.

Objects can not be created dynamically, e.g.

The size of an array has to be known at compile time.

Tech details – Arduino vs processing

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);

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Arduino - elements

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)*

(There's no main())

Tech details - software

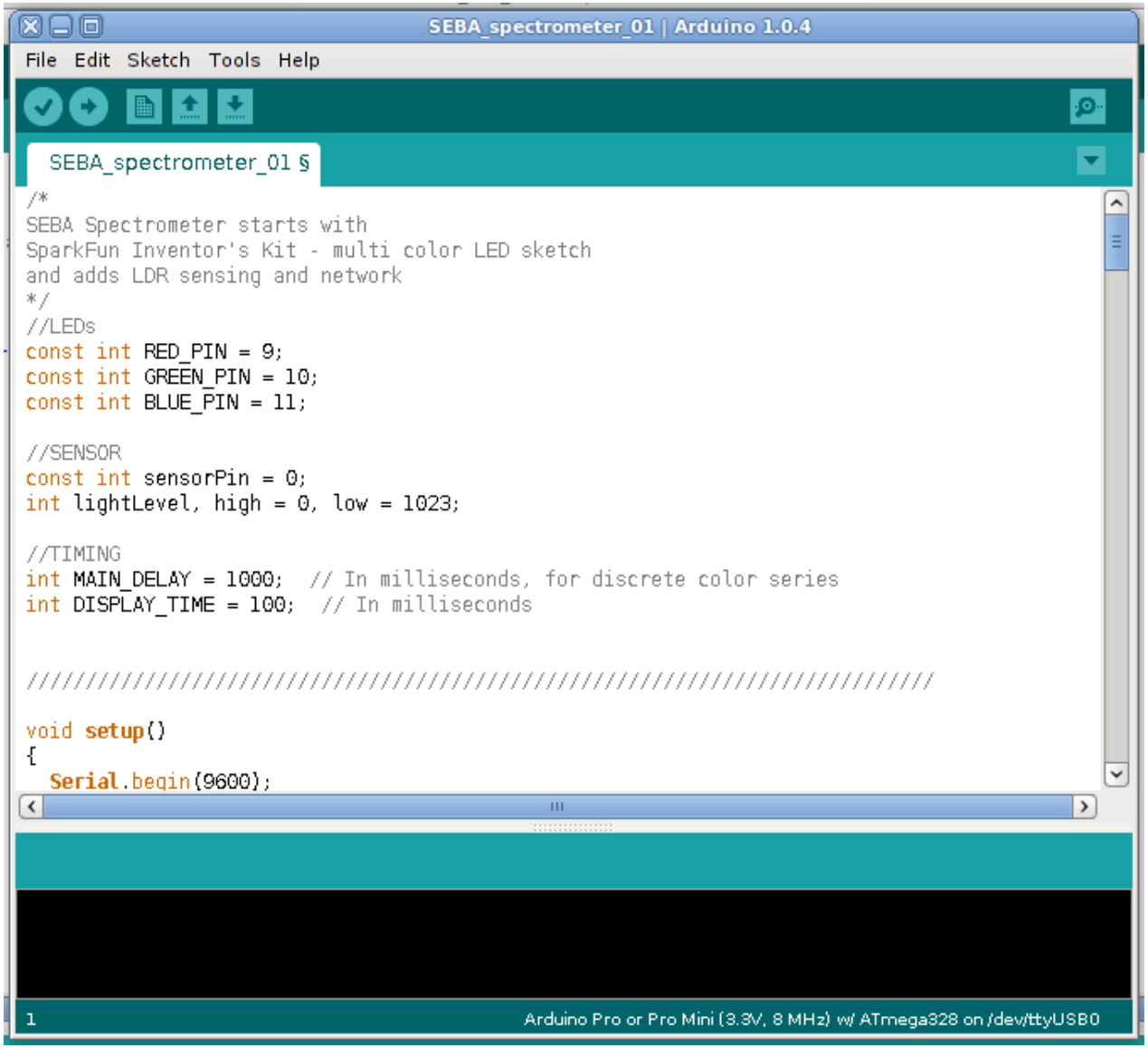
The language offers the familiar set of **operators, variables, functions.**

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



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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.

Think of shields as a kind of adapter,
often providing some extra functionality

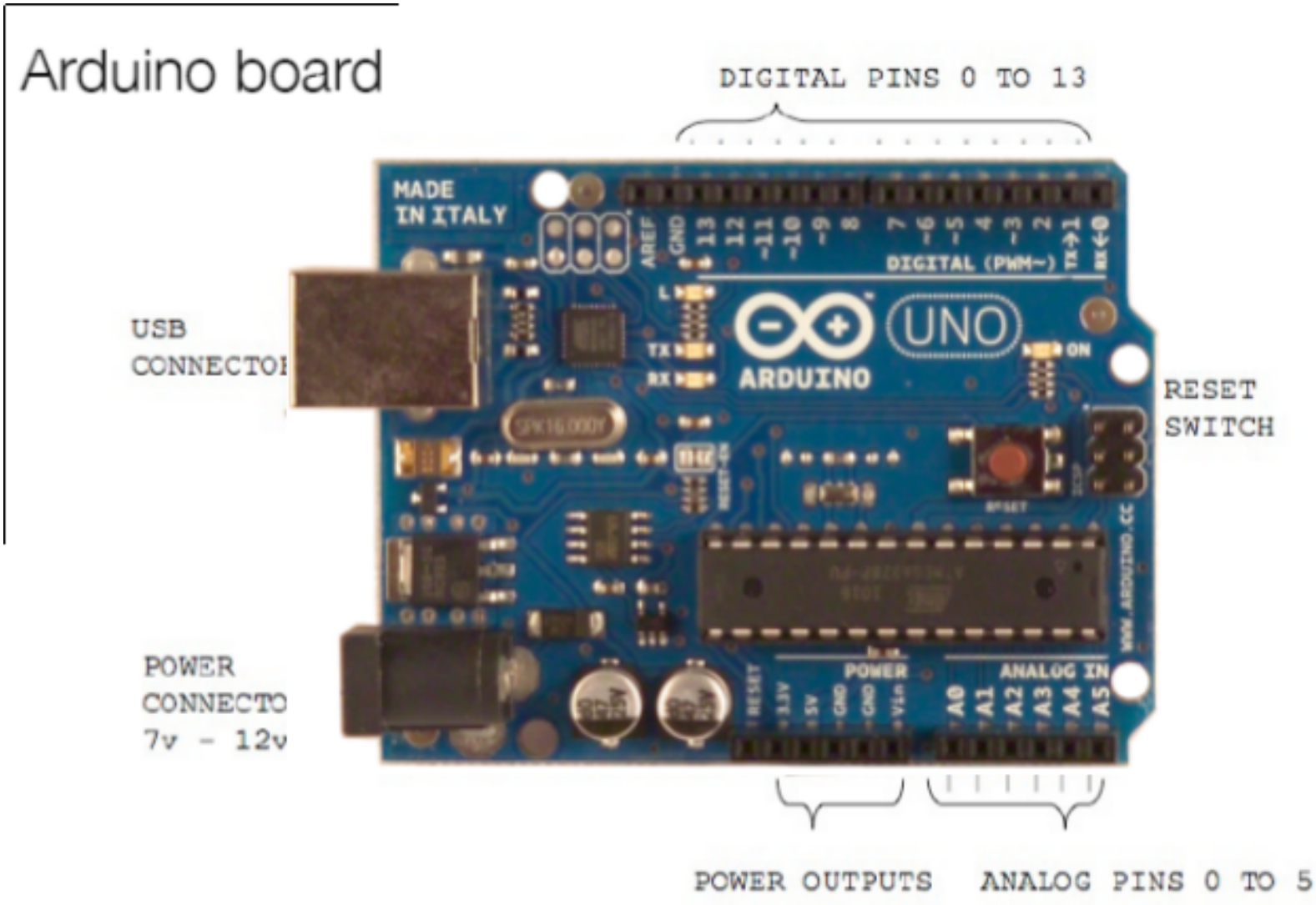
Tech details - hardware

Typical boards:

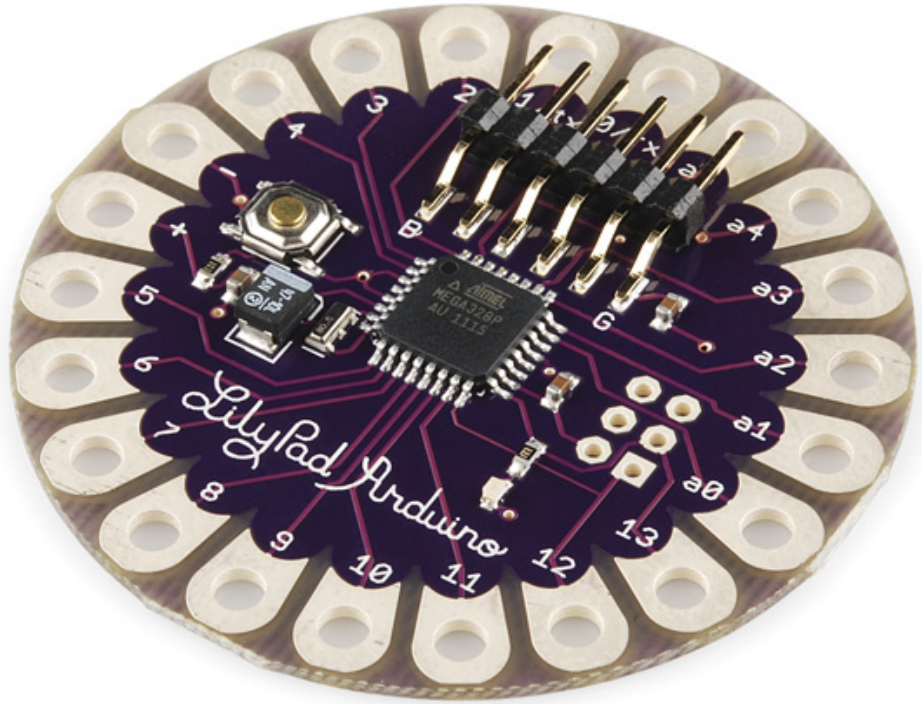
- 8 bit controllers (the 2012 DUE board was first with 32 bit)
- 8 / 16 Mhz
- Typically 32k of memory for code, up to 512k
- Run on 3.3 or 5 Volts (some can take more)

http://arduino.cc/en/Products.Compare

An Arduino board



Arduino boards in many forms



Arduino boards in many forms

Arduino Uno

Arduino Leonardo

Arduino Due

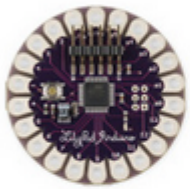
Arduino Esplora

Arduino Mega 2560

Arduino Mega ADK

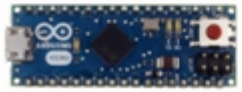
Arduino Ethernet

Arduino Mini



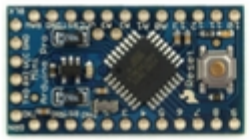
LilyPad Arduino

LilyPad Arduino USB



Arduino Micro

Arduino Nano

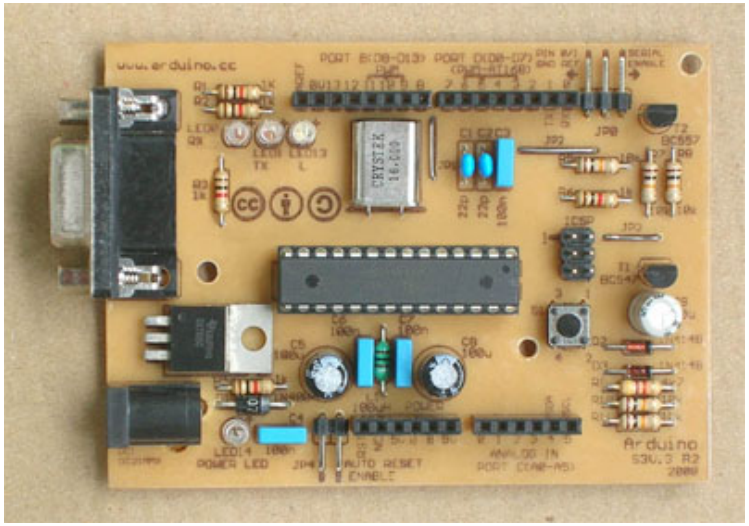


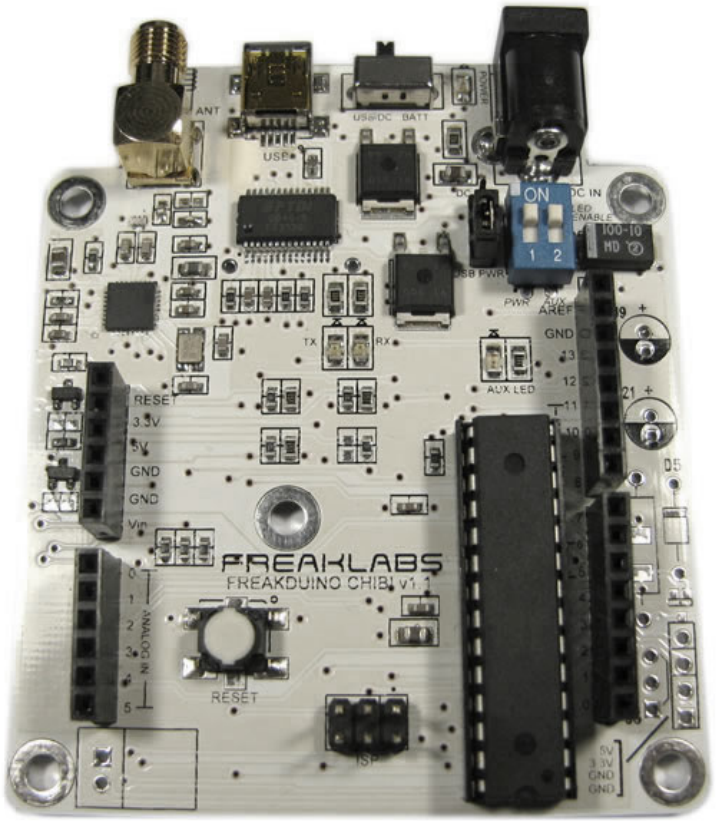
Arduino Pro Mini

Arduino Pro

Arduino Fio

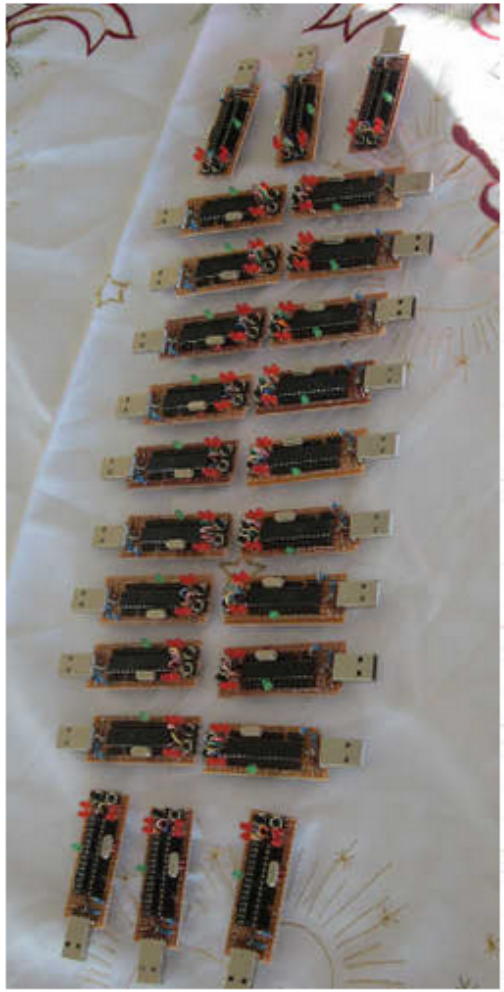
Arduino boards in many forms

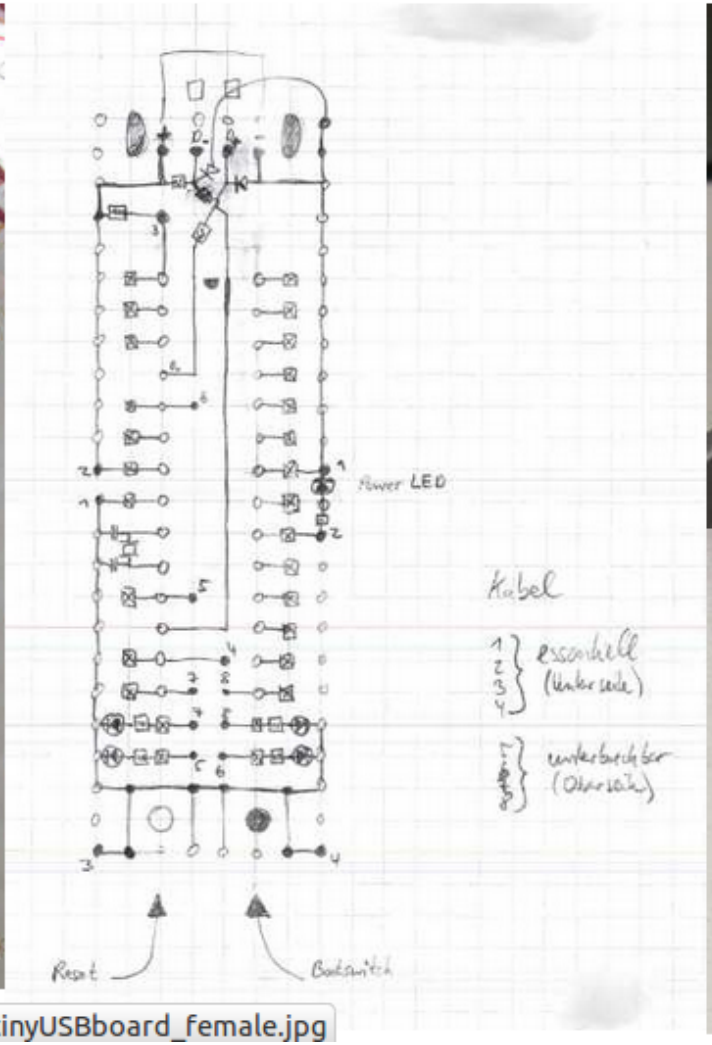




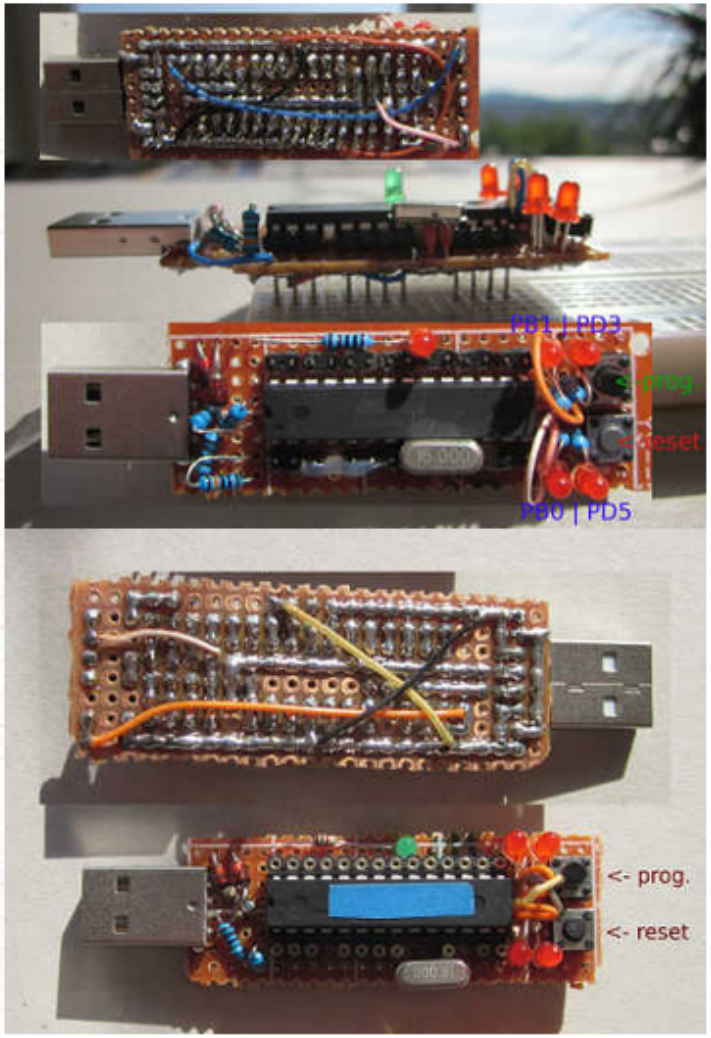
Do your own board

First revision





matrixstorm.com/avr/tinyusbboard/tinyUSBboard_female.jpg



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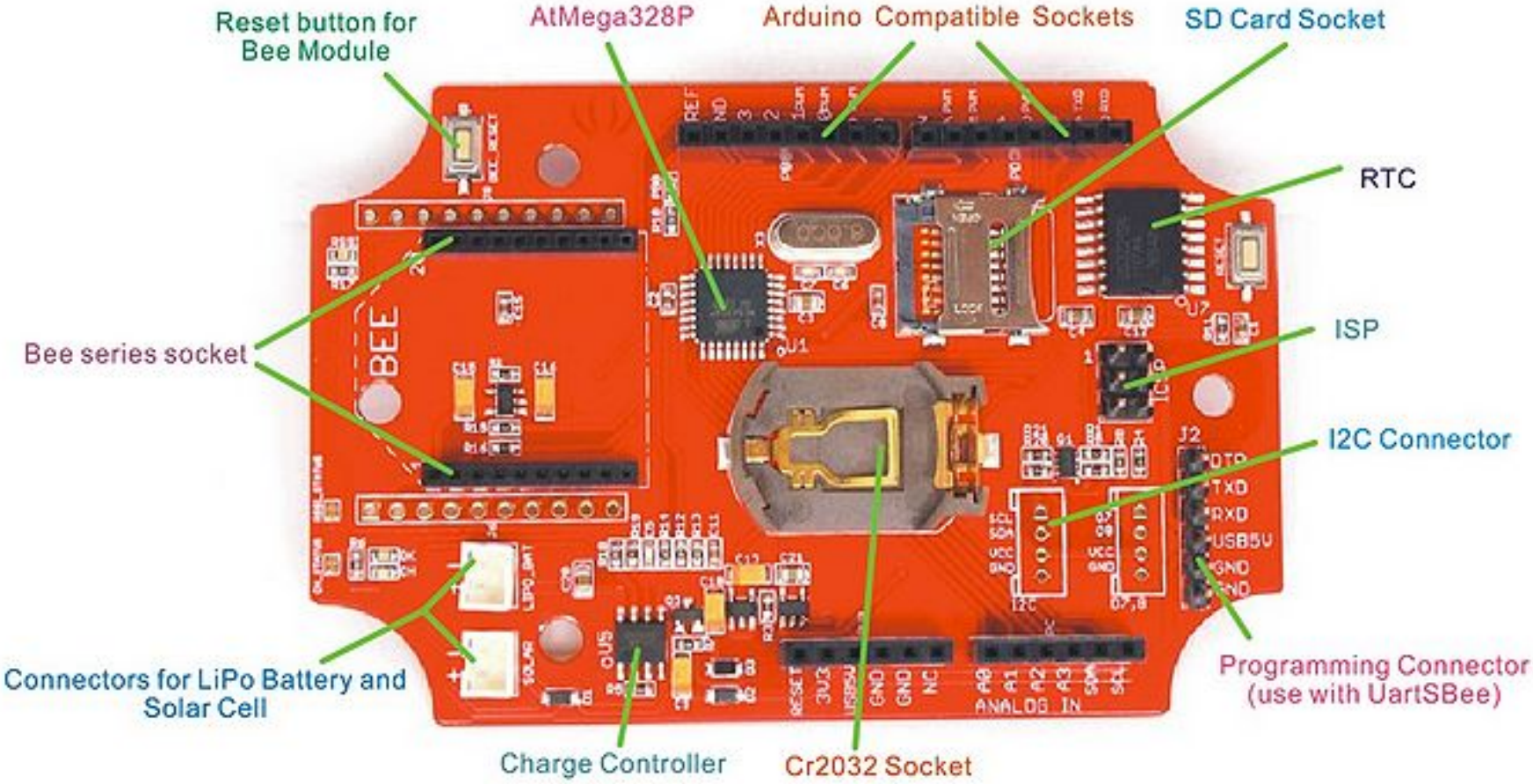
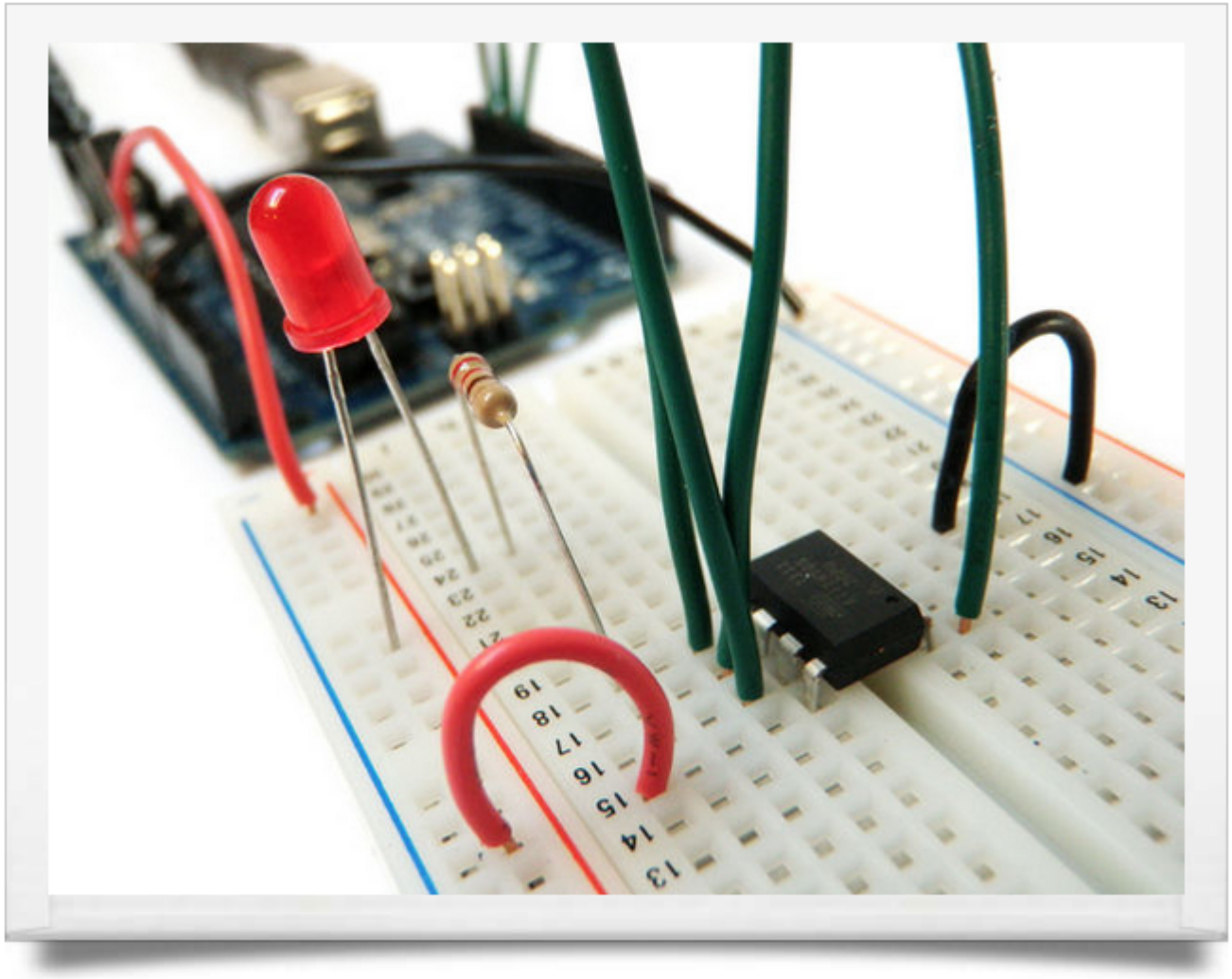
Arduino boards: Seeeduino



Arduino on chip: ATTiny



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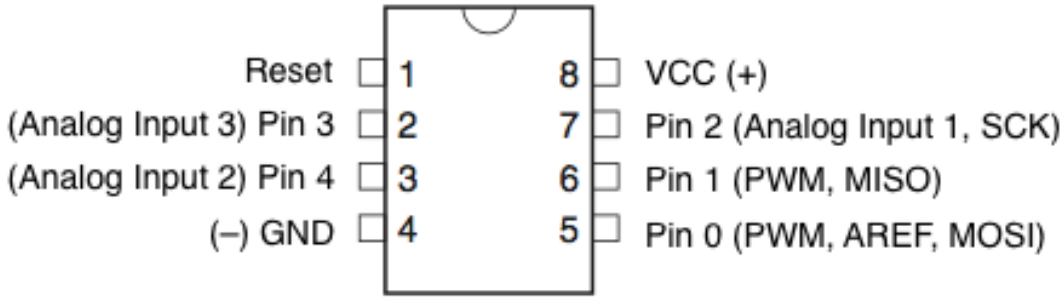
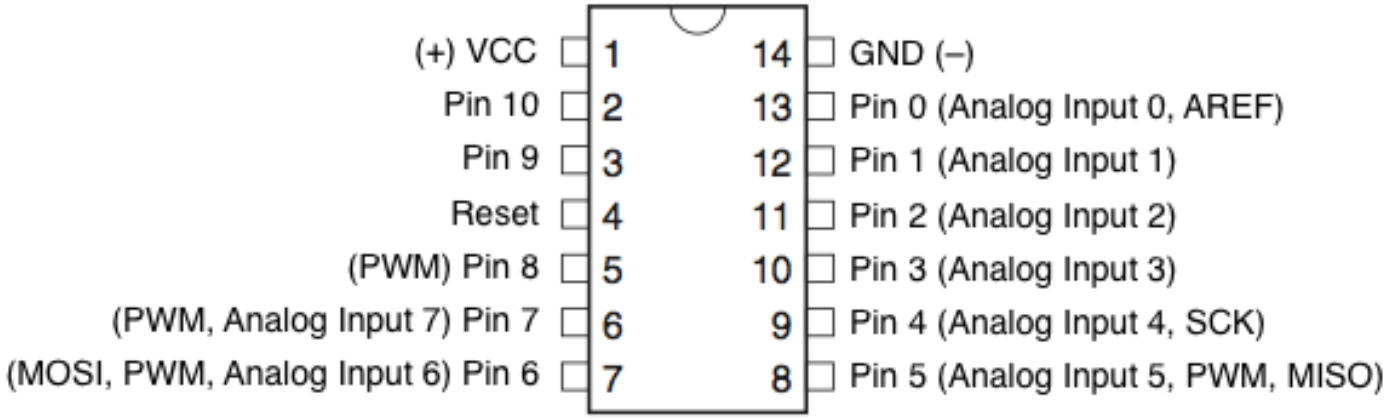
Arduino on chip: ATTiny

ATtiny Microcontroller Pin-Outs

ATtiny45 / ATtiny85



ATtiny44 / ATtiny84



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Arduino - actuators

Actuators

LED

heat plate

motor

piezo/buzzer

relay

fan

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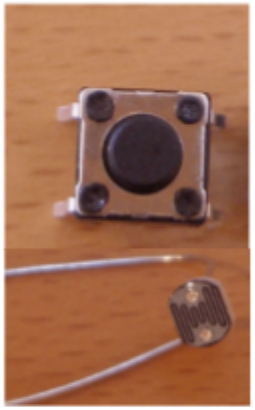
Arduino - sensors

Sensors



button

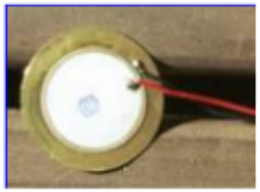
light sensor

heat sensor

RFID reader

proximity sensor

accelerometer



piezo/ pressure sensor

flex sensor

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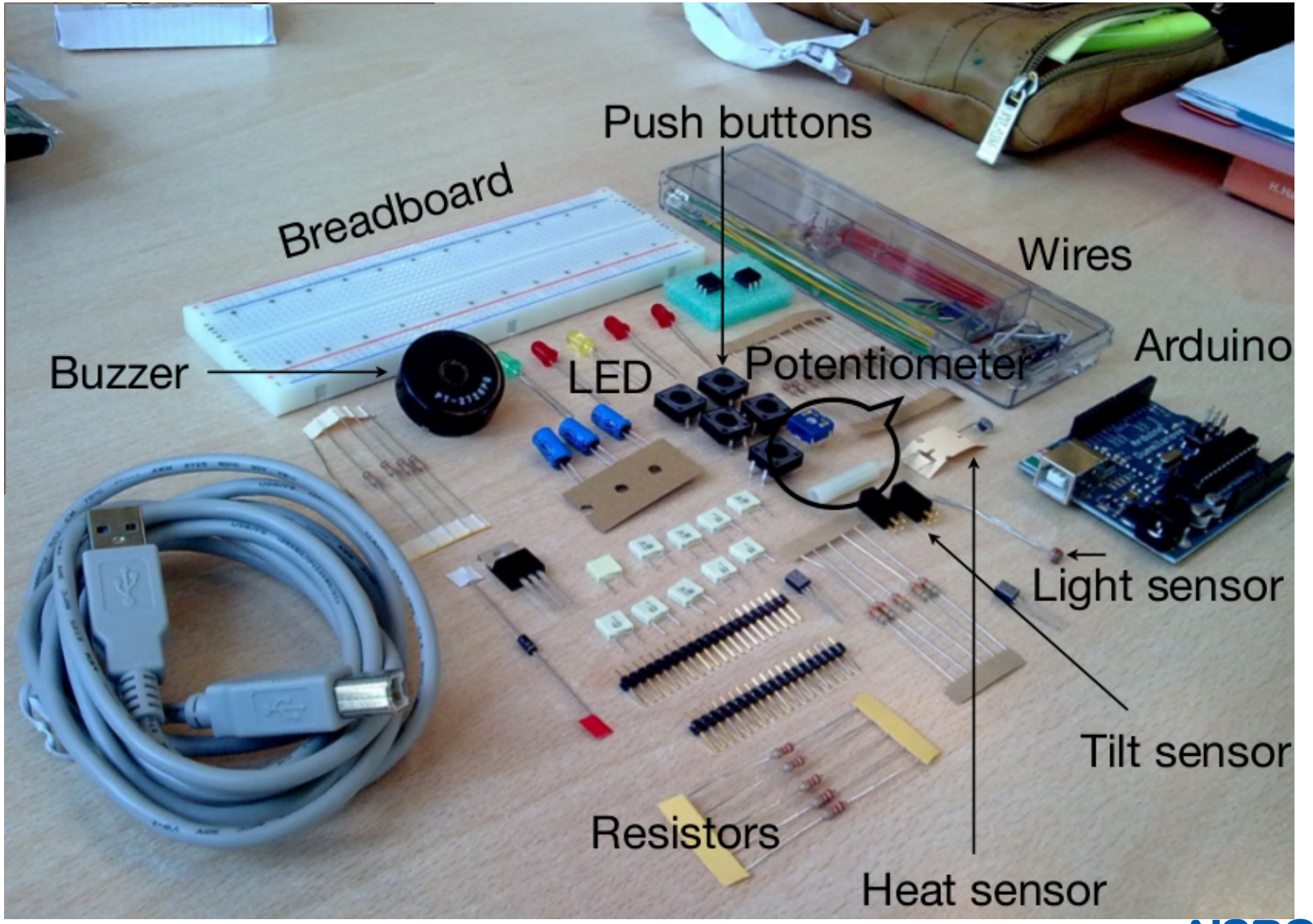
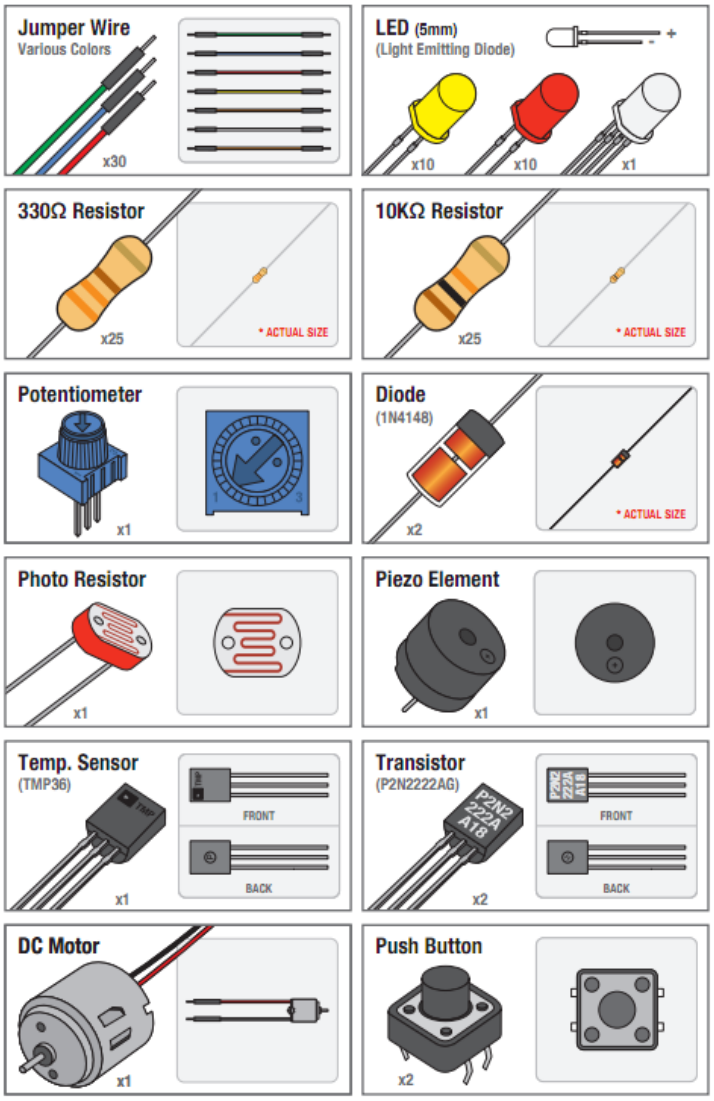
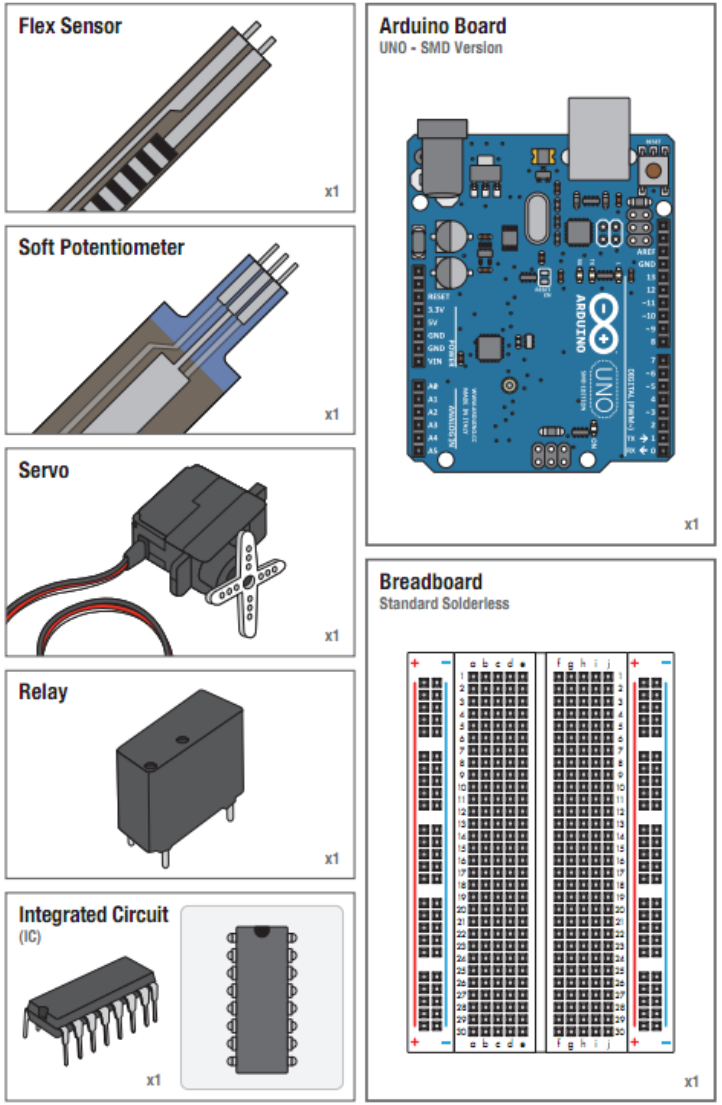
Arduino - kit



Arduino – Sparkfun SIK

Inventory of Parts





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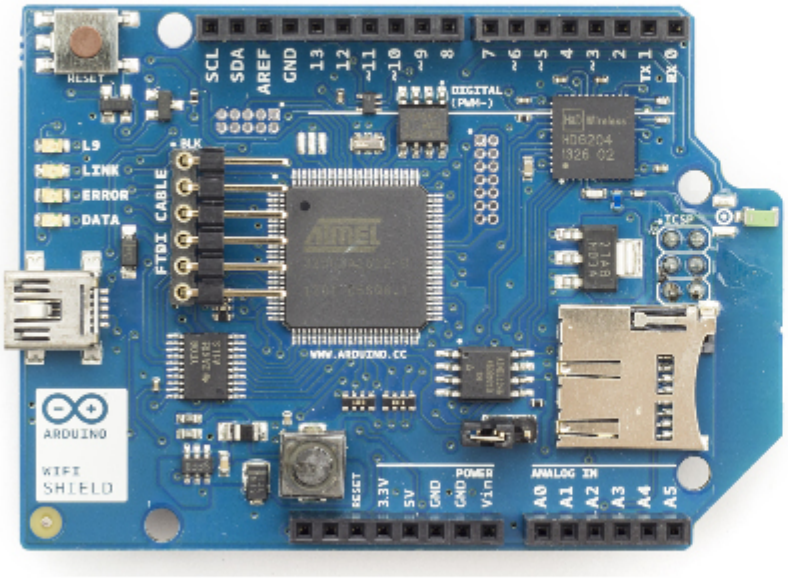
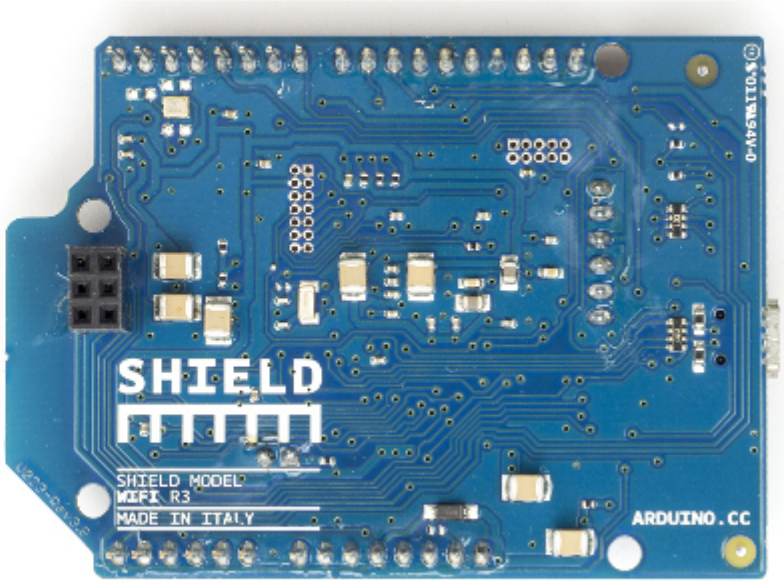
Shields: Arduino WiFi Shield

Arduino WiFi Shield



Arduino WiFi Shield Front



Arduino WiFi Shield Back

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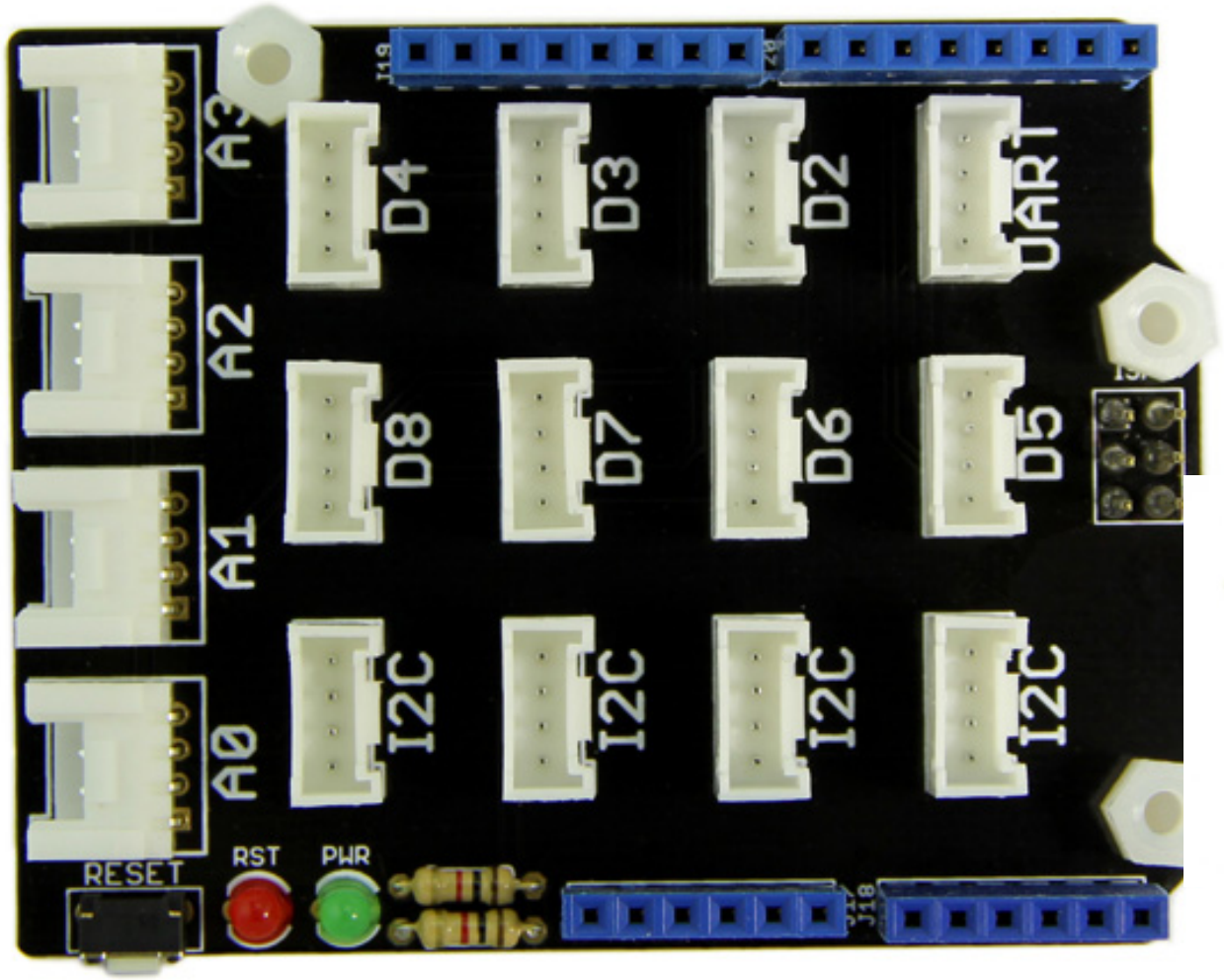
Shields: The Grove system



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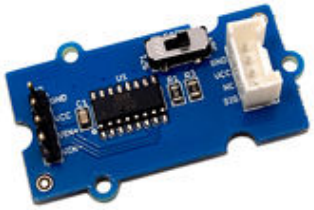
Shields: The Grove system

Grove - Water Sensor

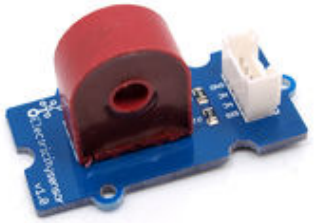
Grove - Magnetic Switch

Grove - Alcohol Sensor

Grove - RTC



Grove - Differential Amplifier



Grove - Electricity Sensor

Grove - Sound Sensor

Grove - IR Distance Interrupt

Grove - Tilt Switch

Grove - Encoder

Grove - I2C Color Sensor

Grove - Sound Recorder

Grove - Moisture Sensor

Grove - PIR Motion Sensor

Grove - Infrared Reflective Sensor

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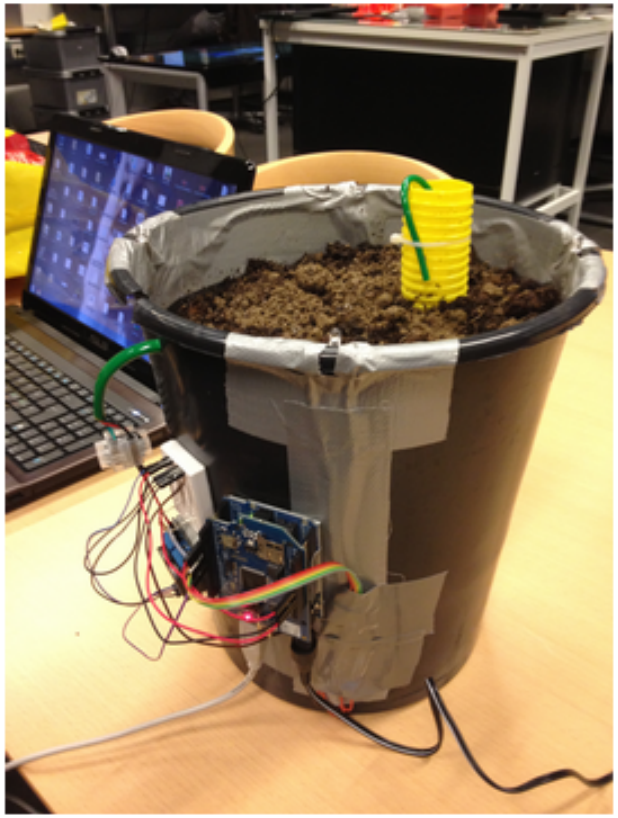
Arduino at ITU: Arducopters

ITU: iPlant project

iPlant
Intelligent Plants

Project Description

People enjoy plants, their benefits and the feeling related to nurturing them. However for most people it becomes challenging to keep them healthy and alive. To accommodate this challenge we have developed a prototype, which makes a plant more selfsufficient, watering itself from a large water tank and providing itself with artificial sunlight. The prototype reports status of its current conditions and also reminds the user to refill the water tank. The system automation is designed to be assistive to the user. We hope that through this prototype people will enjoy having plants without the challenges related to absent or forgetfulness. iPlant is a step towards modern and future homes. Utilising the concepts of pervasive computing where users have complete control over their spaces.



Documentation

- iPlant Report
- Appendix

Showcase

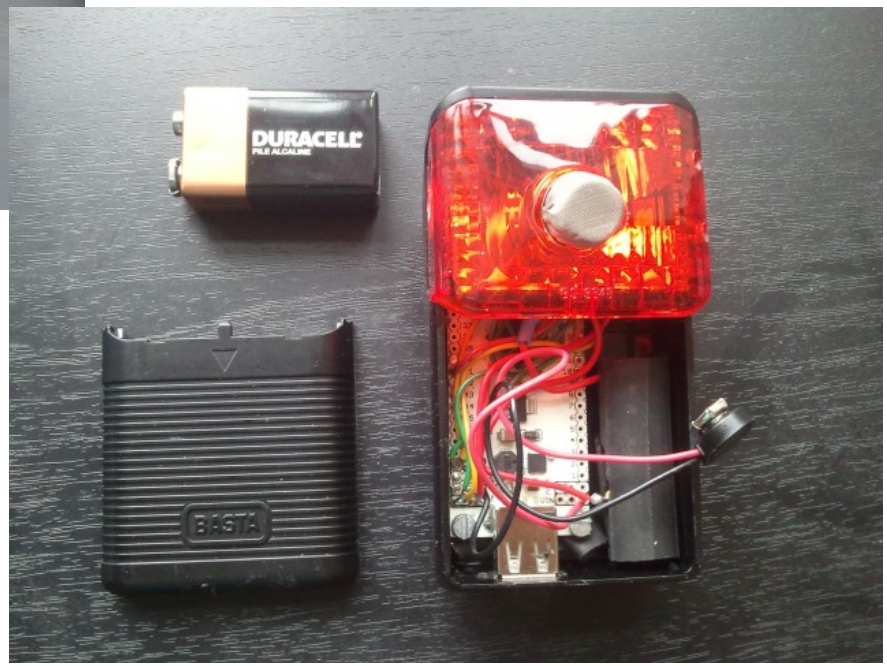
- Data Collection
- Overview
- User Settings

Video

- Concept
- Sensor Monitoring

http://iPlant.dk

ITU: NoXDroid / bAIR project



http://bAIR.dk

IoT / ITU – bAIR.dk

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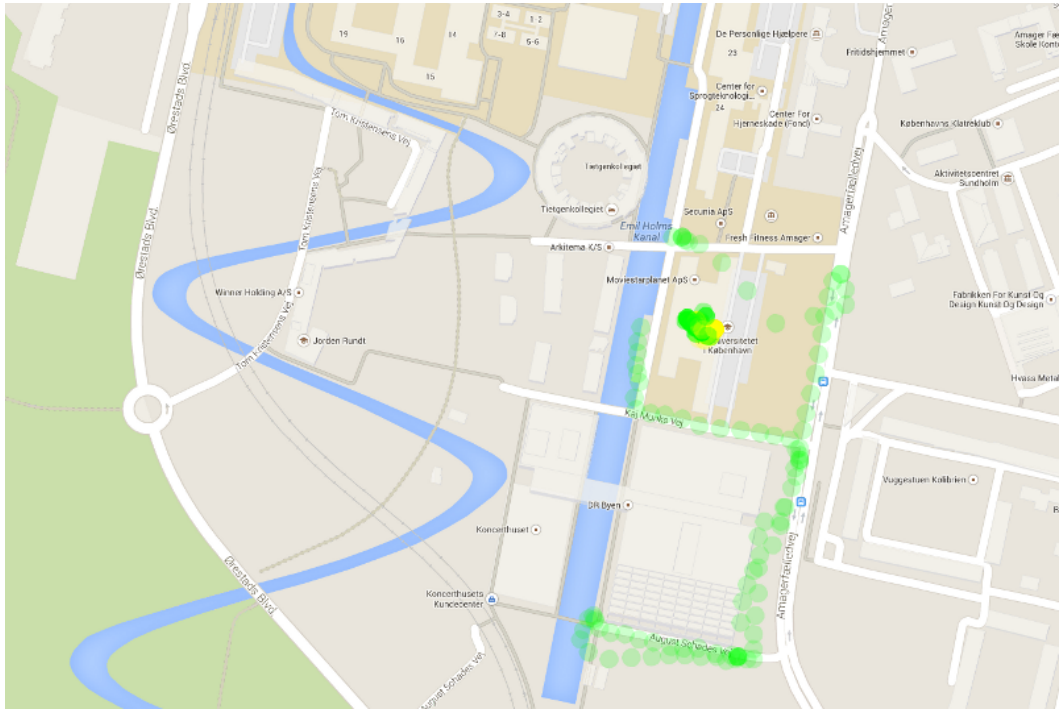
bAIR
the air bike



Saving screenshot...

GRAPH	MAP
438 Air Qual. - RI TGS 2600	65 Sound Level - dB Phone Microphone
Avg 437 / Peak 439	Avg 52 / Peak 96
25 Air humidity - RI RHT03	98 CO Gas - RI TGS2442
Avg 34 / Peak 43	Avg 97 / Peak 98

Stop Recording

Make Note

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[bair.dk]

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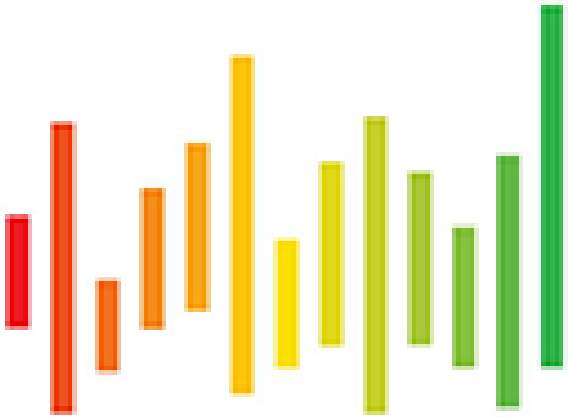
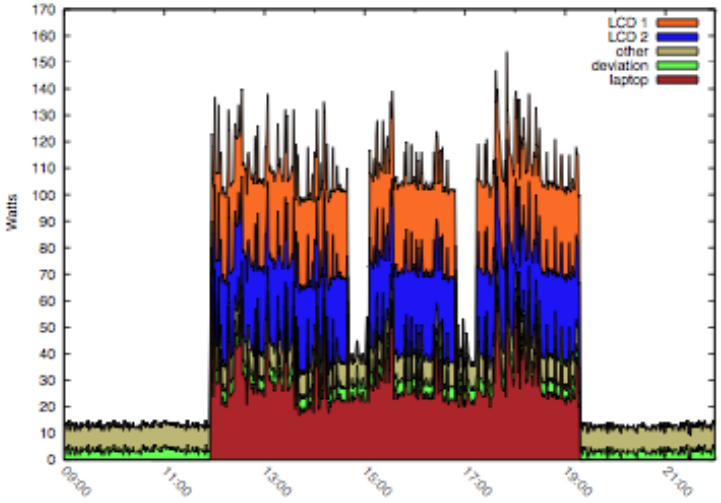
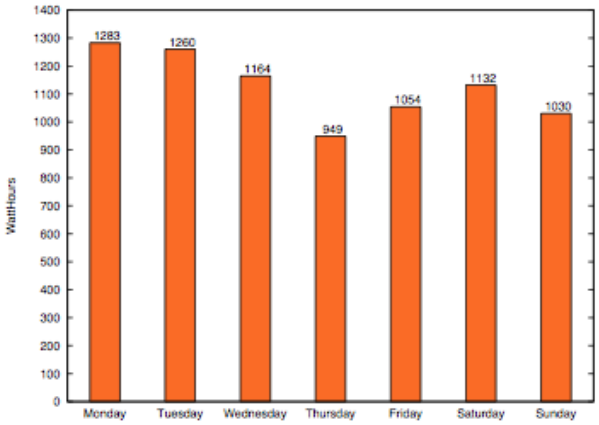
PERVASIVE INTERACTION TECHNOLOGY LABORATORY

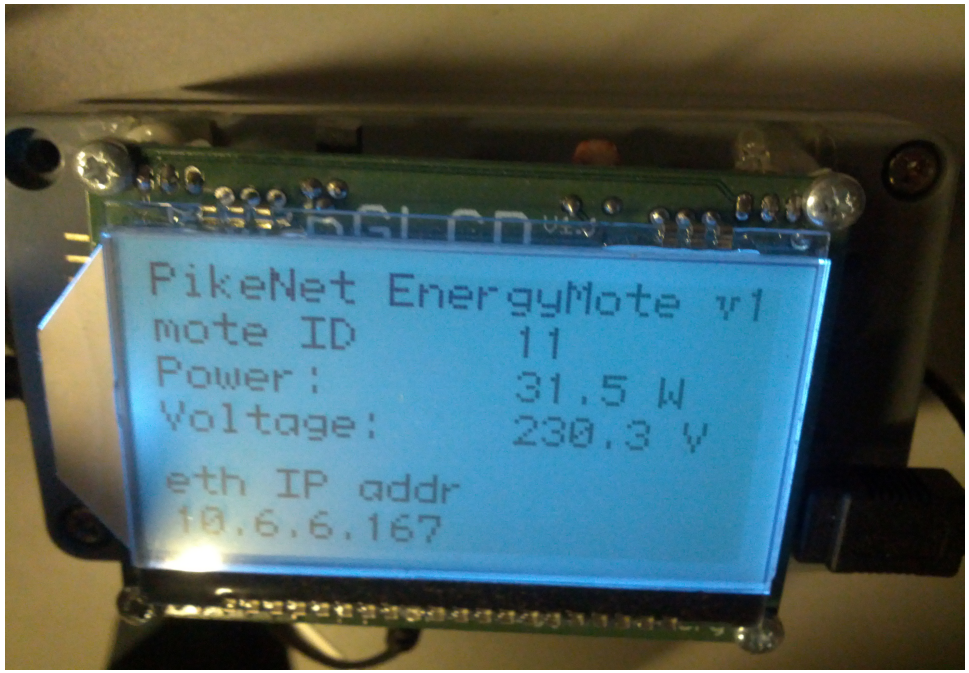
IoT / Energy Futures ITU



ENERGY FUTURES







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[energyfutures.itu.dk]

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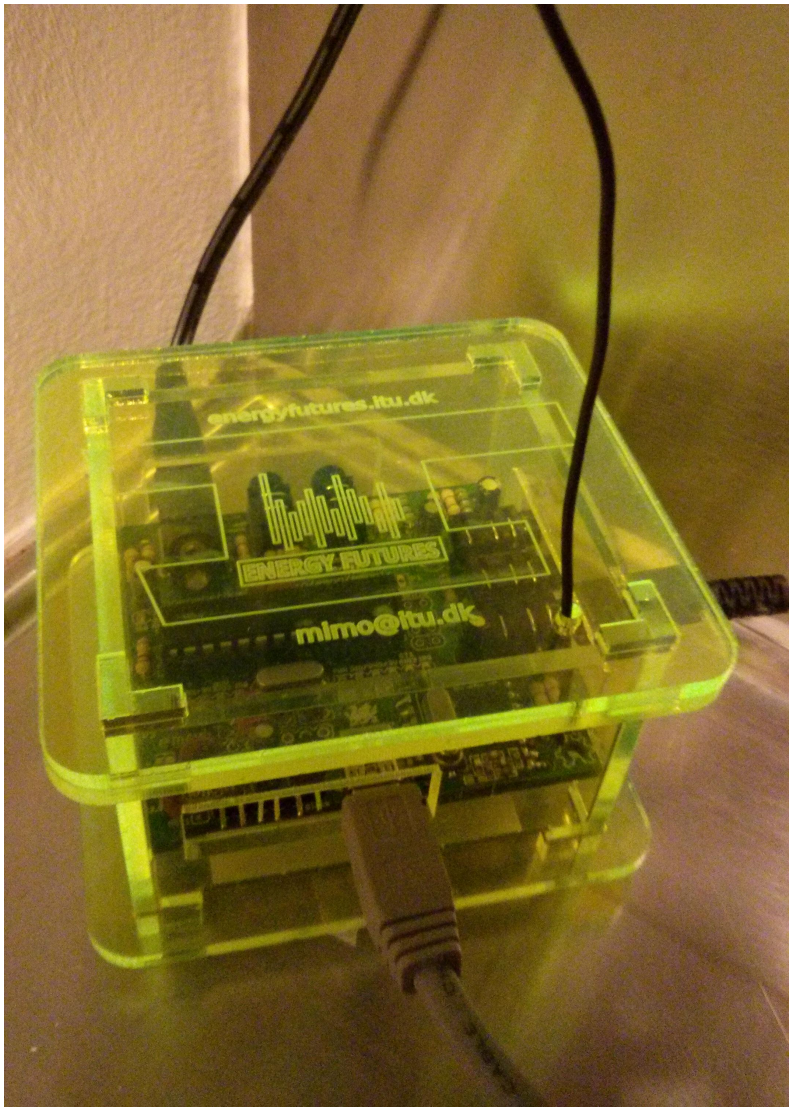
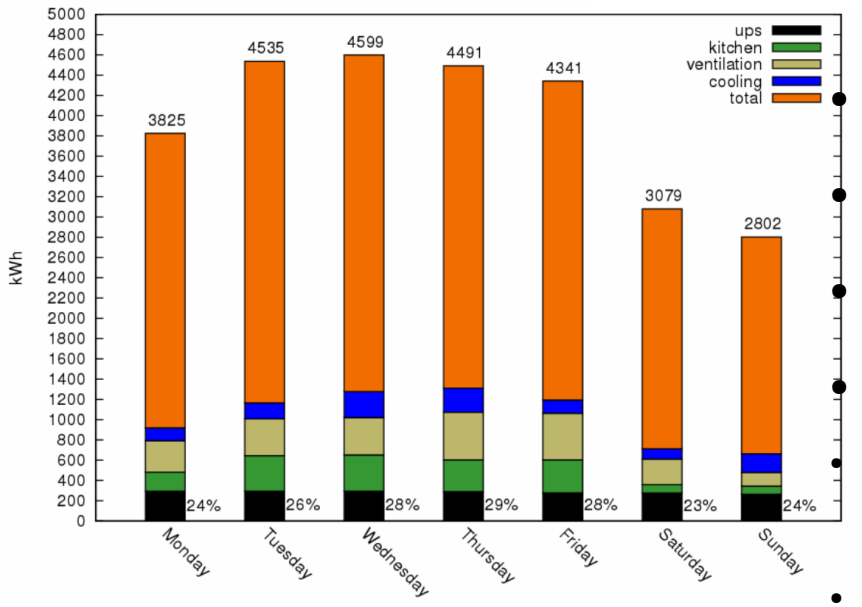
ENERGY FUTURES

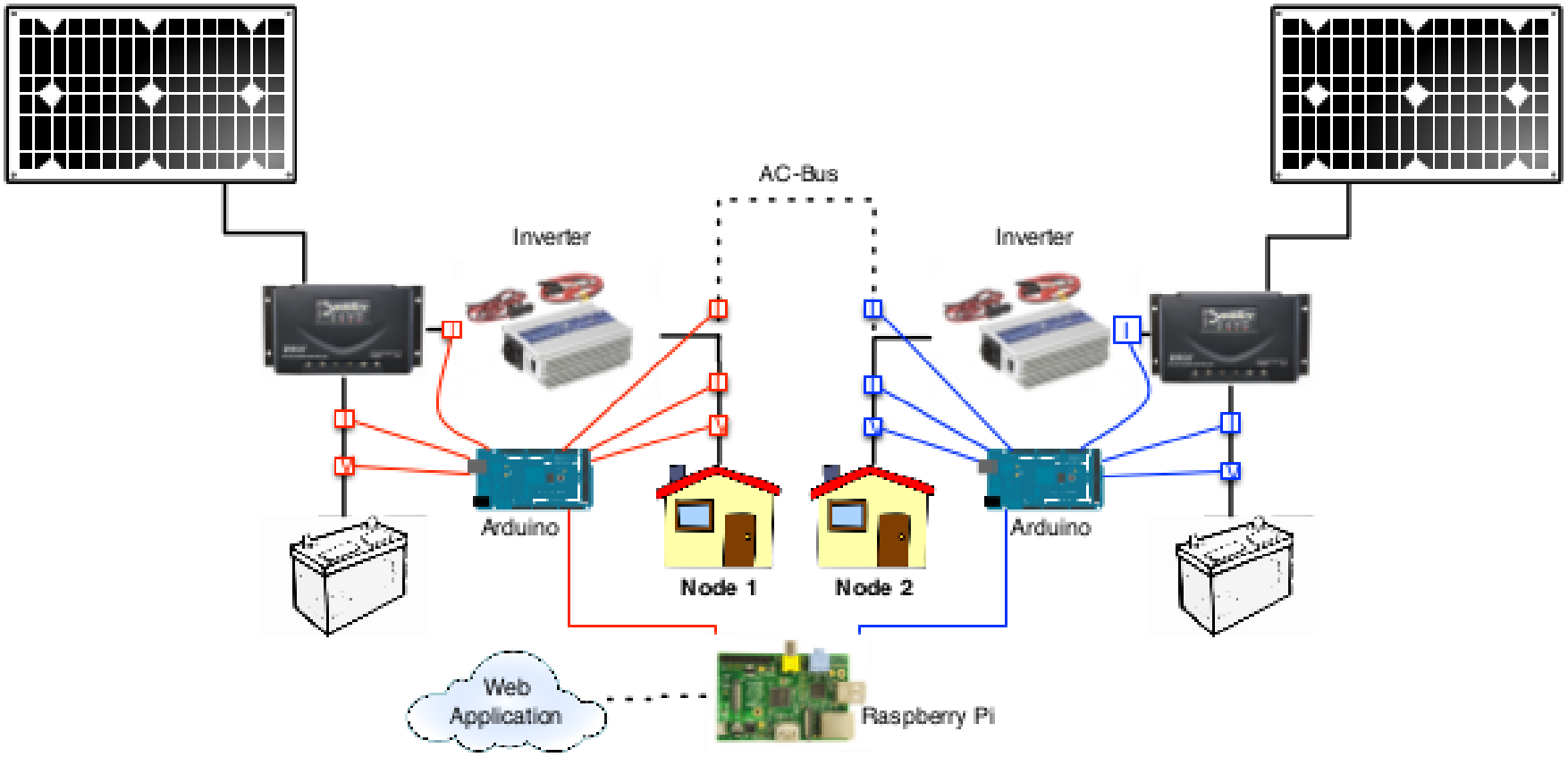




10% reduction in power consumption over one year, without any big changes - just understanding and adjusting

ENERGY FUTURES

COSMGrid – a low cost solar micro-grid



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