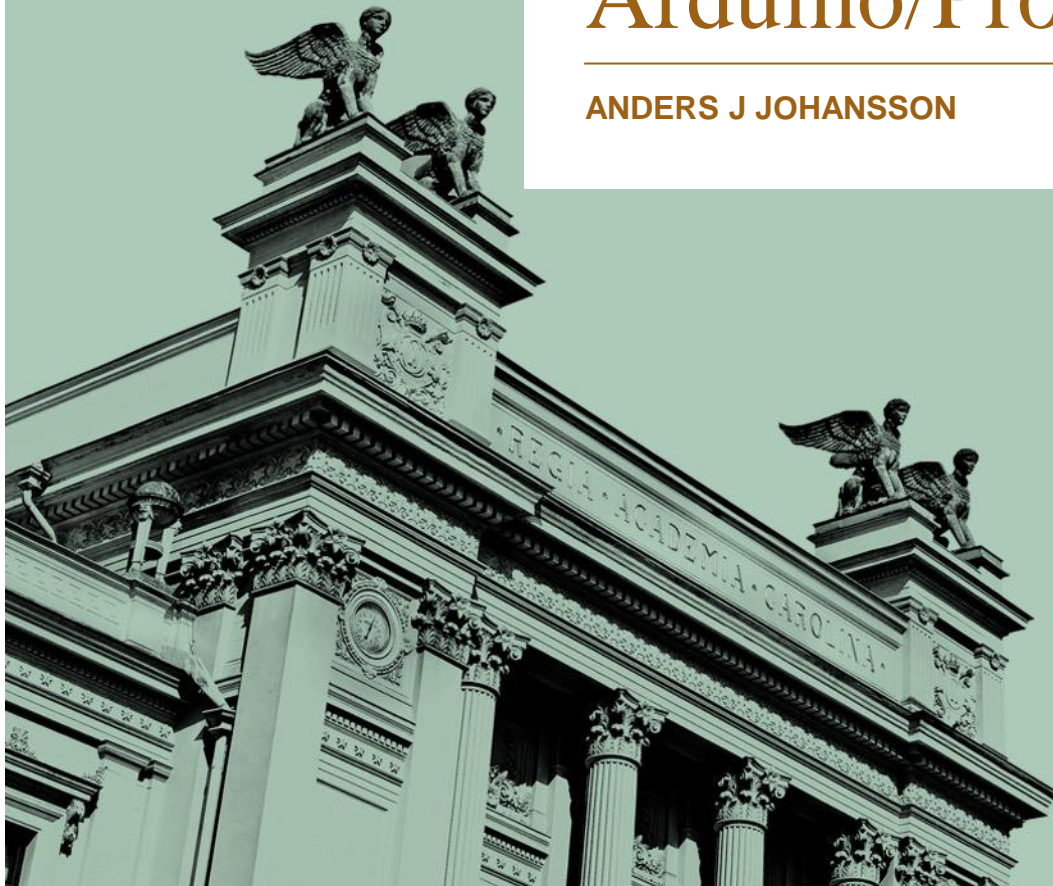




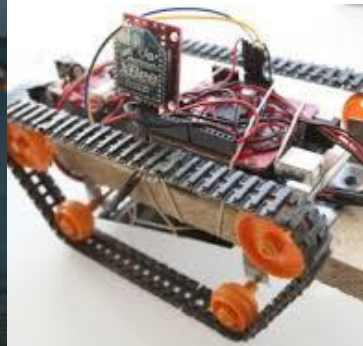
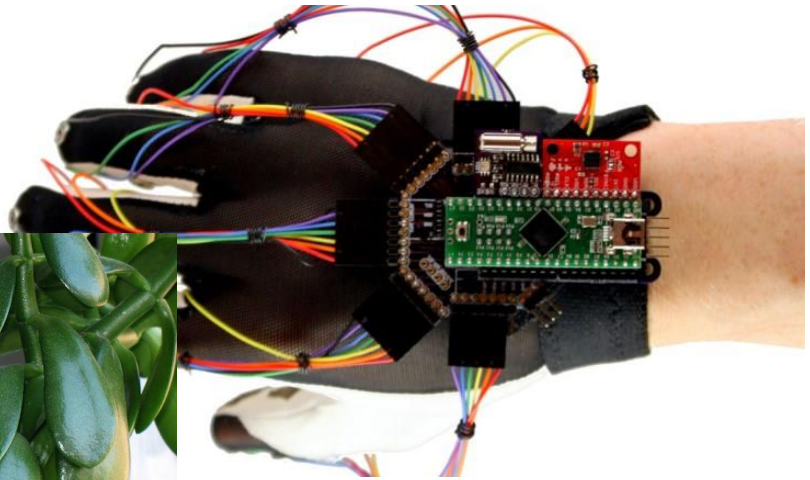
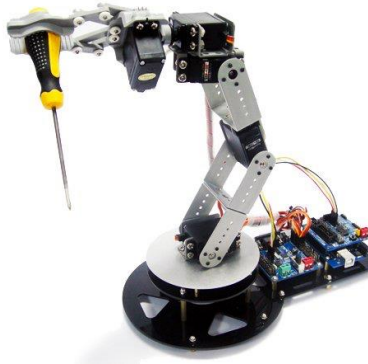
LUND
UNIVERSITY

Introduction to Arduino/Processing

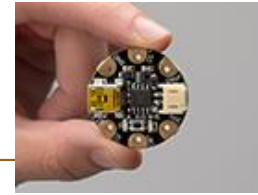
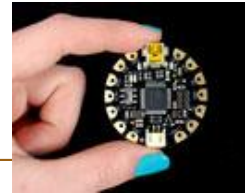
ANDERS J JOHANSSON



Examples of projects using Arduino



Wearable Electronics

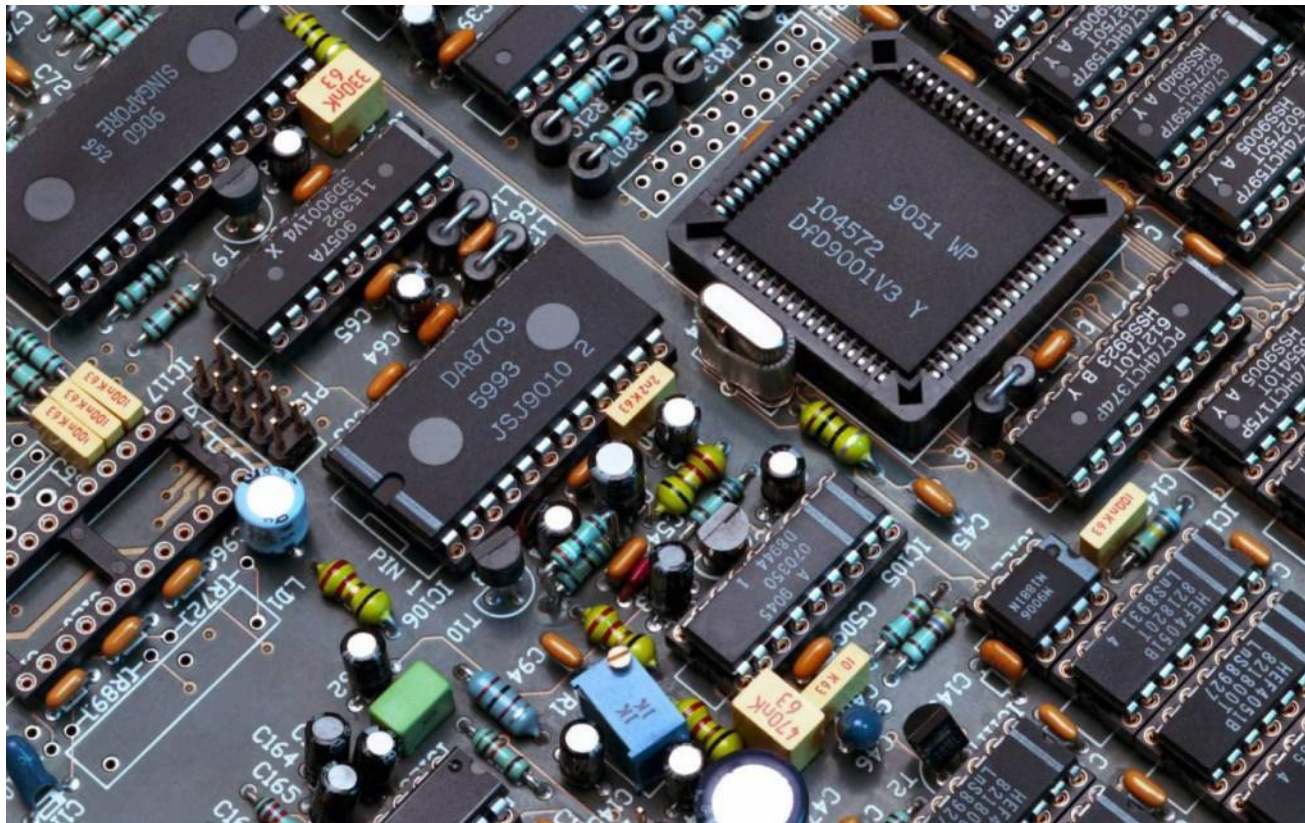


Flora, Lilypad, Gemma



Microcontroller - Embedded systems

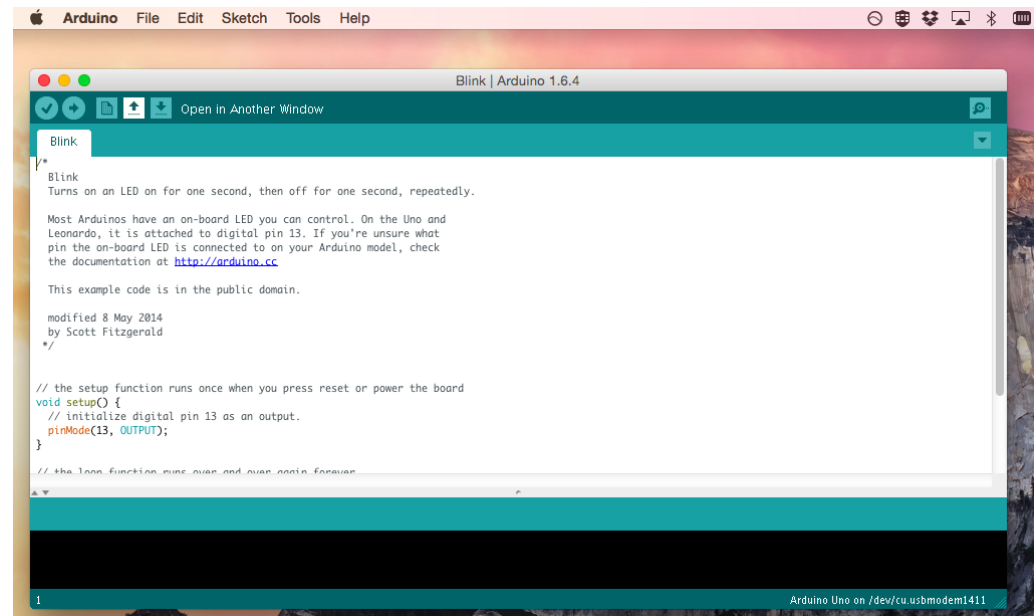
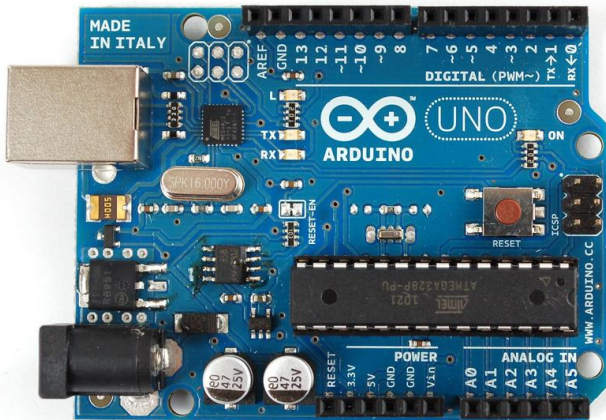
- Usable for quick prototypes.



Arduino

Hardware

Software + IDE (Integrated Development Environment)



Processing



- Cover
- Download
- Exhibition
- Reference
- Libraries
- Tools
- Environment

- Tutorials
- Examples
- Books
- Handbook



Welcome to Processing 3! Dan explains the new features and changes; the links Dan mentions are on the [Vimeo page](#).

>> Exhibition



Stewart – A mutually trustful interface for a fully autonomous car
by Felix Ros



Open source

Mjukvara

Java-environment

- GPL



C/C++ bibliotek

- LGPL



Hårdvara

- Kretsscheman
- CAD-filer (Eagle-cad)

Creative Commons Licens

- Share alike
- Attribution



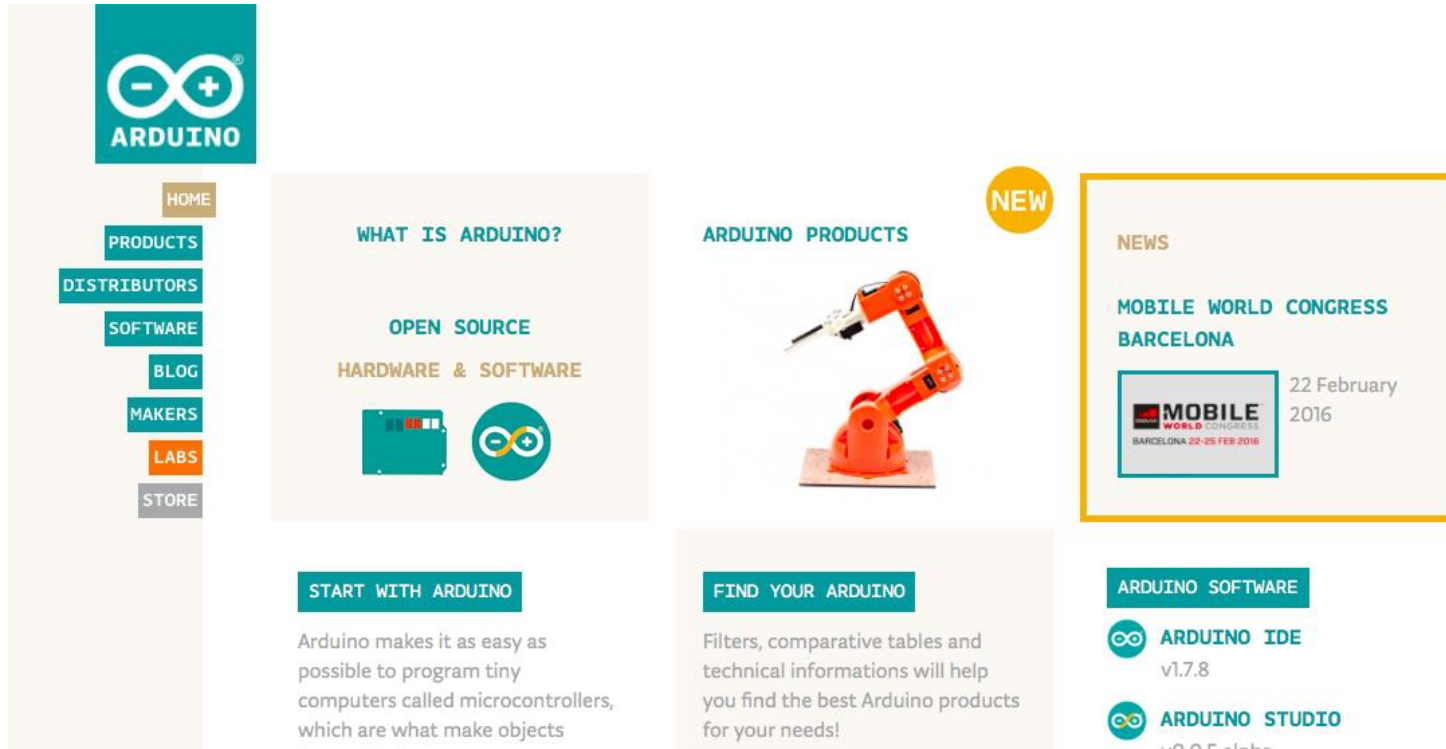
How to make something simple complicated...



vs



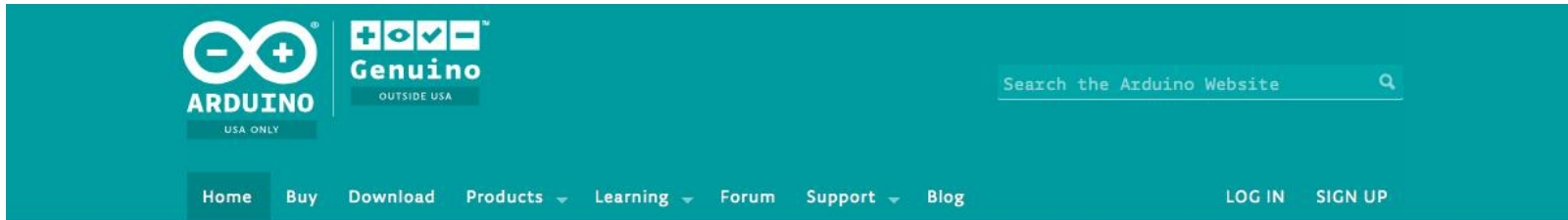
Arduino.org



The screenshot shows the Arduino.org homepage layout. On the left is a vertical navigation menu with buttons for HOME, PRODUCTS, DISTRIBUTORS, SOFTWARE, BLOG, MAKERS, LABS, and STORE. The main content area is divided into three columns. The first column, titled 'WHAT IS ARDUINO?', features the text 'OPEN SOURCE HARDWARE & SOFTWARE' and images of an Arduino board and the logo. Below this is a 'START WITH ARDUINO' section with a paragraph: 'Arduino makes it as easy as possible to program tiny computers called microcontrollers, which are what make objects...'. The second column, titled 'ARDUINO PRODUCTS', has a 'NEW' badge and an image of an orange robotic arm. Below is a 'FIND YOUR ARDUINO' section with text: 'Filters, comparative tables and technical informations will help you find the best Arduino products for your needs!'. The third column, titled 'NEWS', is highlighted with a yellow border and features a 'MOBILE WORLD CONGRESS BARCELONA' article dated '22 February 2016'. Below the news section are two software links: 'ARDUINO IDE v1.7.8' and 'ARDUINO STUDIO v0.0.5 alpha'.



Arduino.cc



The header features the Arduino logo on the left, which includes the infinity symbol with a minus and plus sign, the word "ARDUINO", and "USA ONLY" below it. To the right is the "Genuino" logo with "OUTSIDE USA" underneath. A search bar on the right contains the text "Search the Arduino Website" and a magnifying glass icon. Below these elements is a navigation menu with links for Home, Buy, Download, Products, Learning, Forum, Support, and Blog. On the far right of the menu are "LOG IN" and "SIGN UP" links.



WHAT IS ARDUINO?

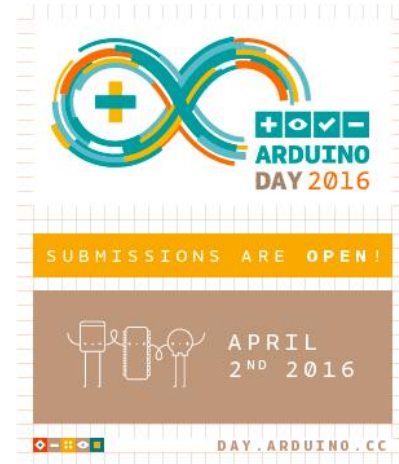

[BUY AN ARDUINO](#) 


[LEARN ARDUINO](#) 





BLOG

MACCHINA POETICA
CONVERTS SOUNDS INTO
ONOMATOPOEIC WORDS




ARDUINO DAY 2016

SUBMISSIONS ARE OPEN!

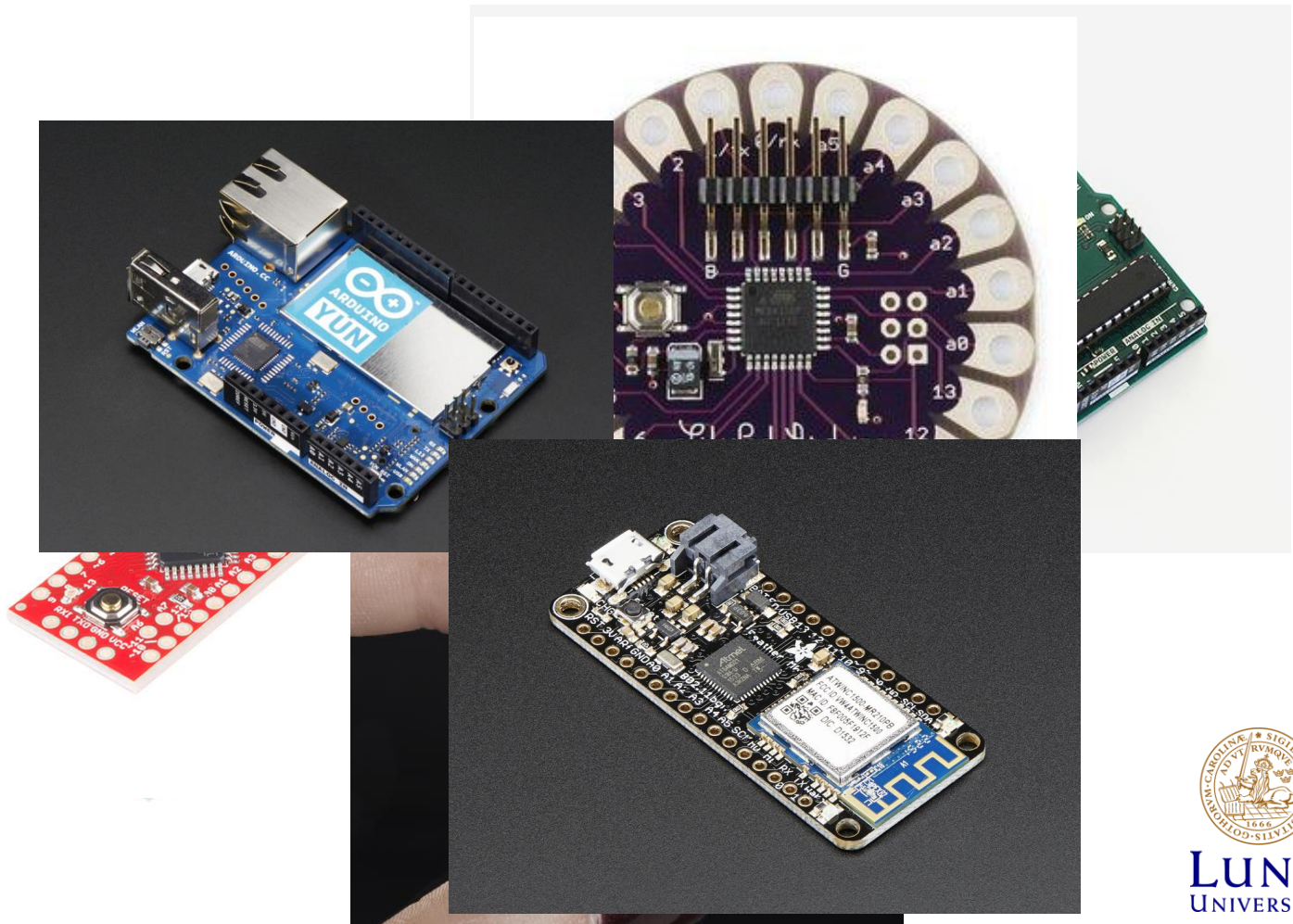
 APRIL
2ND 2016

 DAY.ARDUINO.CC



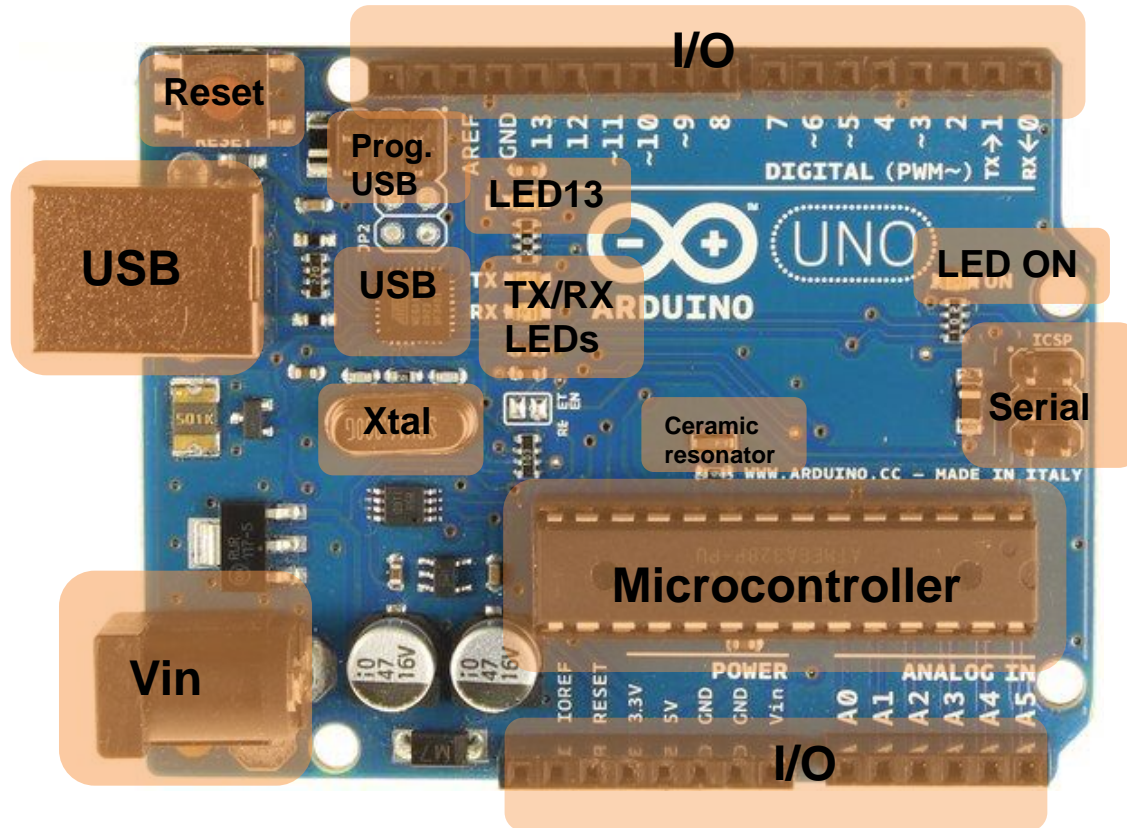
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Arduino hardware

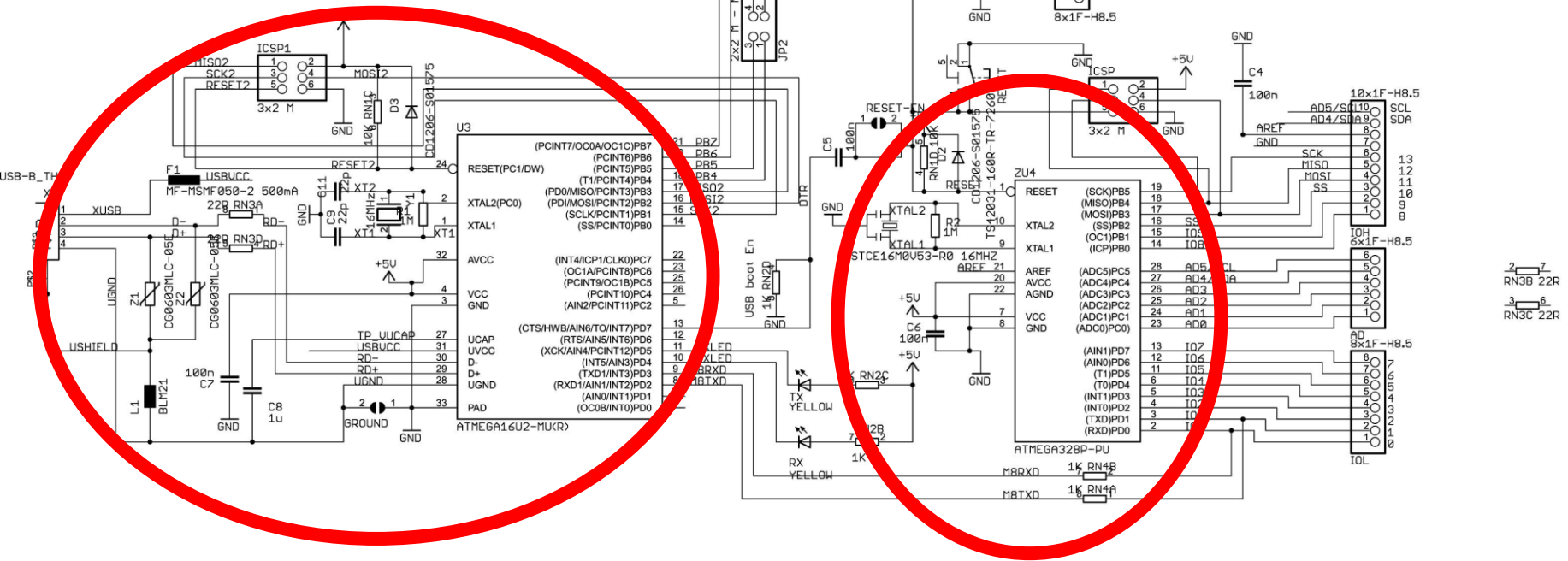
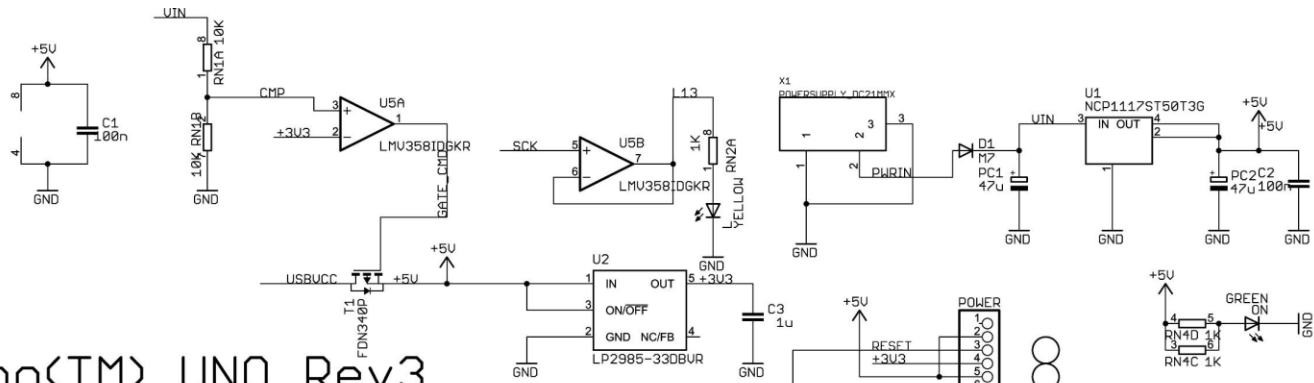


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Arduino UNO



Arduino(TM) UNO Rev3



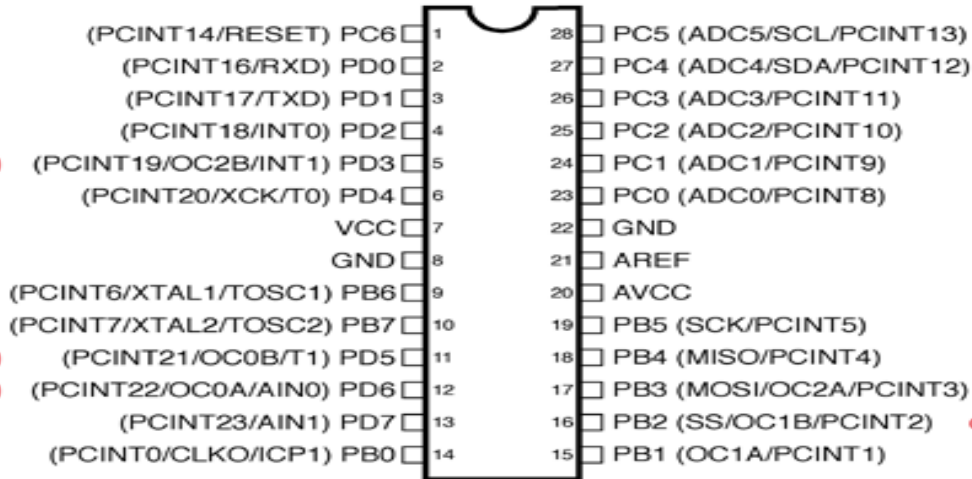
Reference Designs ARE PROVIDED "AS IS" AND "WITH ALL FAULTS. Arduino DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTIES REGARDING PRODUCTS, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Arduino may make changes to specifications and product descriptions at any time without notice. User must not rely on the absence or characteristics of any features or instructions marked "reserved" or "undefined. Arduino reserves the right to change these for future definition and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to them. The product information on the Web Site or Materials is subject to change without notice. Do not finalize a design with this information. ARDUINO is a registered trademark. Use of the ARDUINO name must be compliant with <http://www.arduino.cc/en/Main/Policy>

Arduino pins vs. Atmega 328

Atmega168 Pin Mapping

Arduino function

reset
 digital pin 0 (RX)
 digital pin 1 (TX)
 digital pin 2
 digital pin 3 (PWM)
 digital pin 4
 VCC
 GND
 crystal
 crystal
 digital pin 5 (PWM)
 digital pin 6 (PWM)
 digital pin 7
 digital pin 8



Arduino function

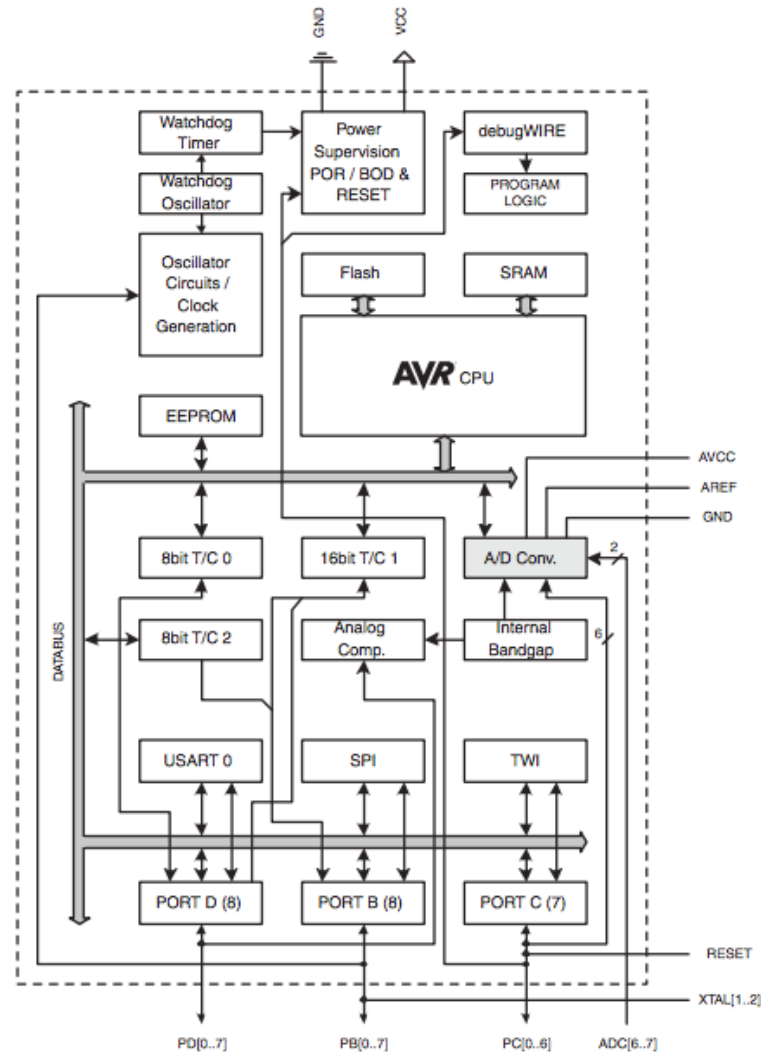
analog input 5
 analog input 4
 analog input 3
 analog input 2
 analog input 1
 analog input 0
 GND
 analog reference
 VCC
 digital pin 13
 digital pin 12
 digital pin 11 (PWM)
 digital pin 10 (PWM)
 digital pin 9 (PWM)

Digital Pins 11, 12 & 13 are used by the ICSP header for MOSI, MISO, SCK connections (Atmega168 pins 17, 18 & 19). Avoid low-impedance loads on these pins when using the ICSP header.

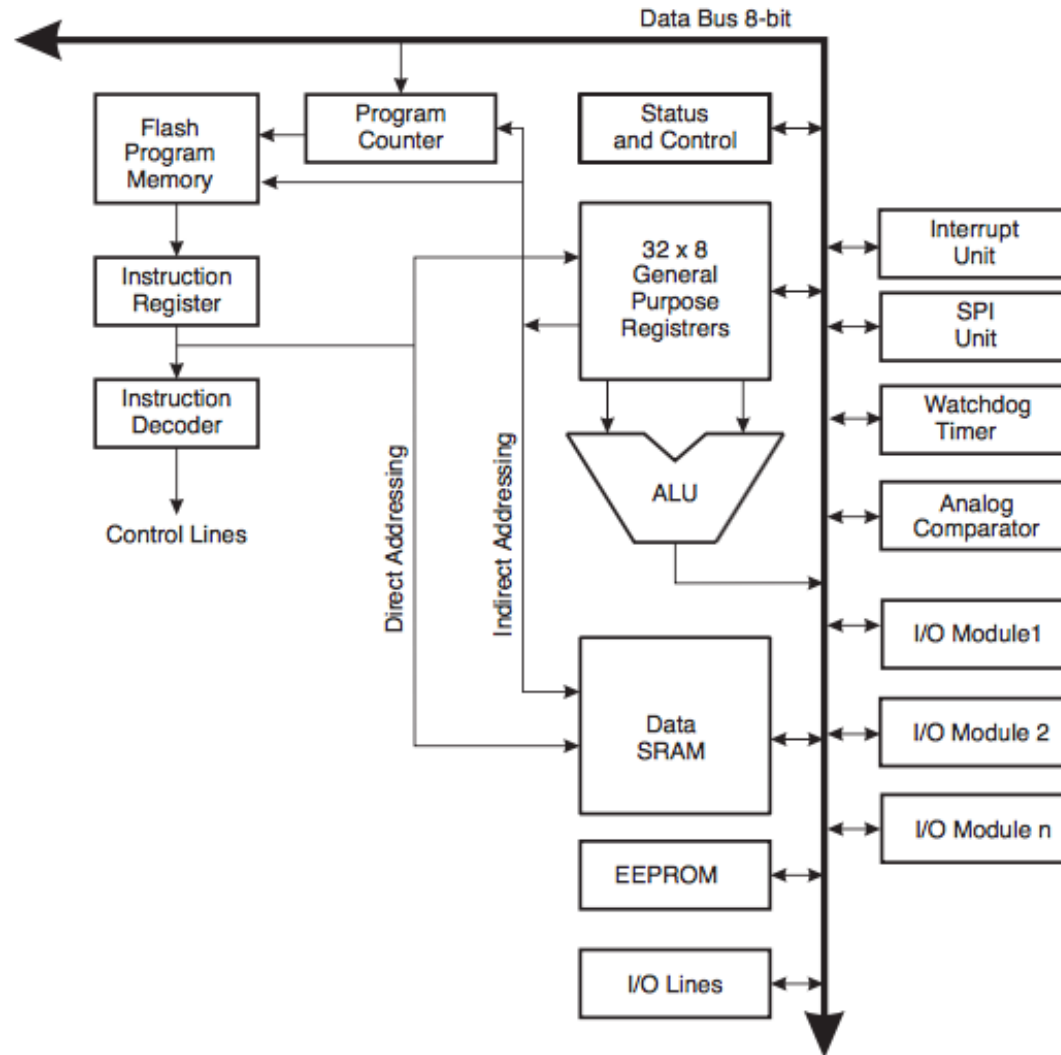


Inside the microcontroller

Block Diagram



Inside the CPU



Arduino: The programming language

Structure

setup()

loop()

Digital I/O

pinMode()

digitalWrite()

digitalRead()

Analog I/O

analogReference()
e()

analogRead()

analogWrite()

Control Structures

if

if...else

for

switch case

while

do... while

break

continue

return

goto



Variables

Data Types

void (0)

boolean (1B)

char (1B)

unsigned char
(1B)

byte (1B)

int (2B)

unsigned int (2B)

word (2B)

long (4B)

unsigned long (4B)

short (2B)

float (4B)

double (4B)

string - char array

String _ object array



What you don't get:

- Memory to spare
- Multi-threading



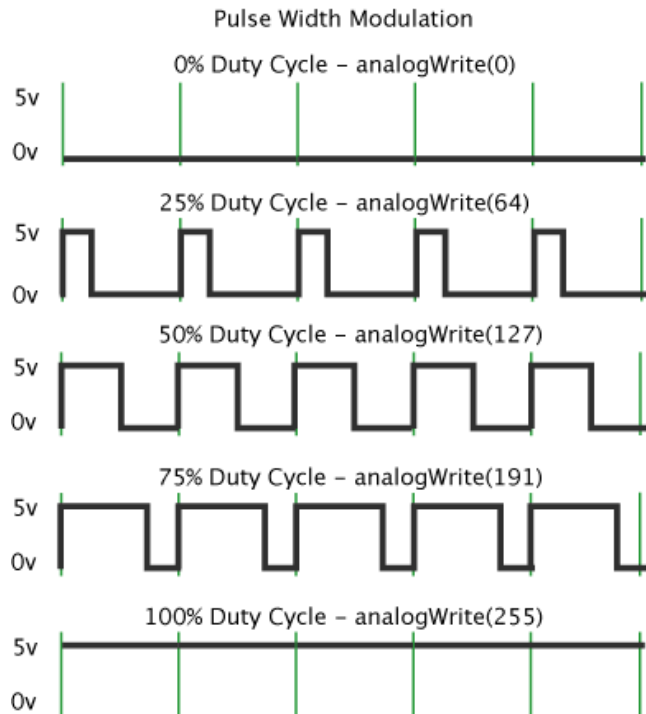
I/O portar



- 6 Analog inouts
- 14 digital I/O
 - 6 with PWM output (3,5,6,9,10,11)
- Bus-support
 - I2C/TWI (A4, A5)
 - SPI (10,11,12,13)
 - TTL serial (USB och 0,1)
- External interrupts (2,3)
- LED (13)



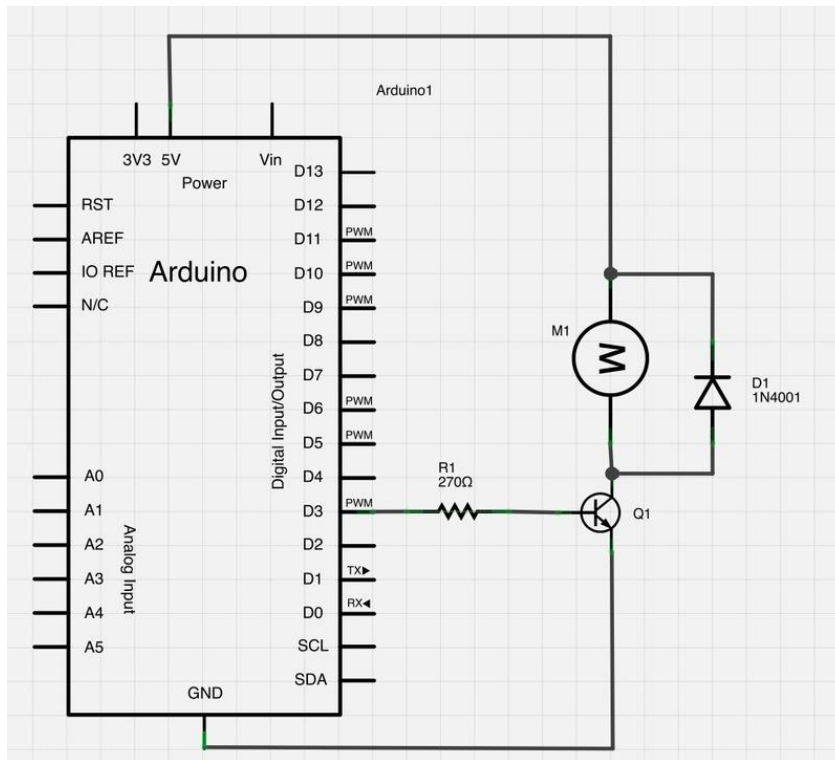
PWM



- Pulse Width Modulation
- Demands low pass filtering to be a continuous signal
 - Low-pass filter (R-C)
 - Eye
 - Motor
 - etc



Motors



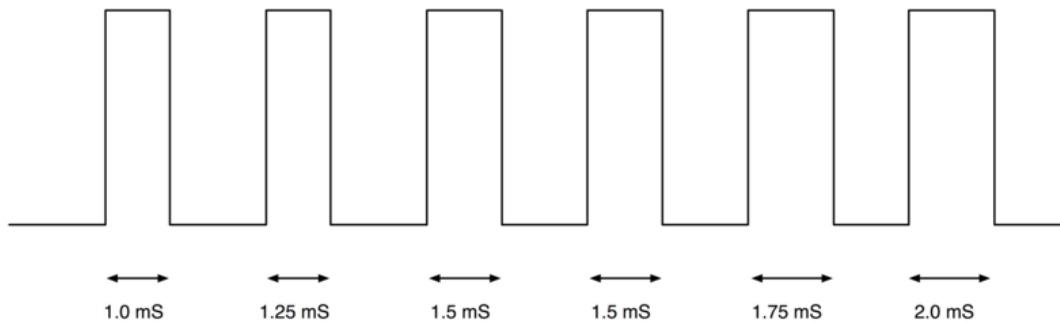
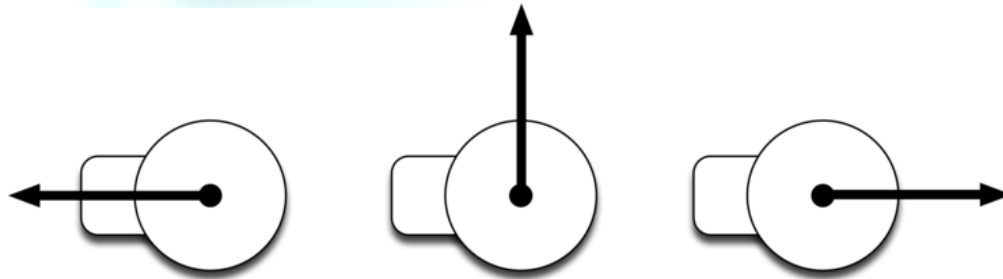
- Use PWM
- Add diod as protection from induced current
- Use a transistor to control the current. ($I_{max} = 20\text{mA}$)



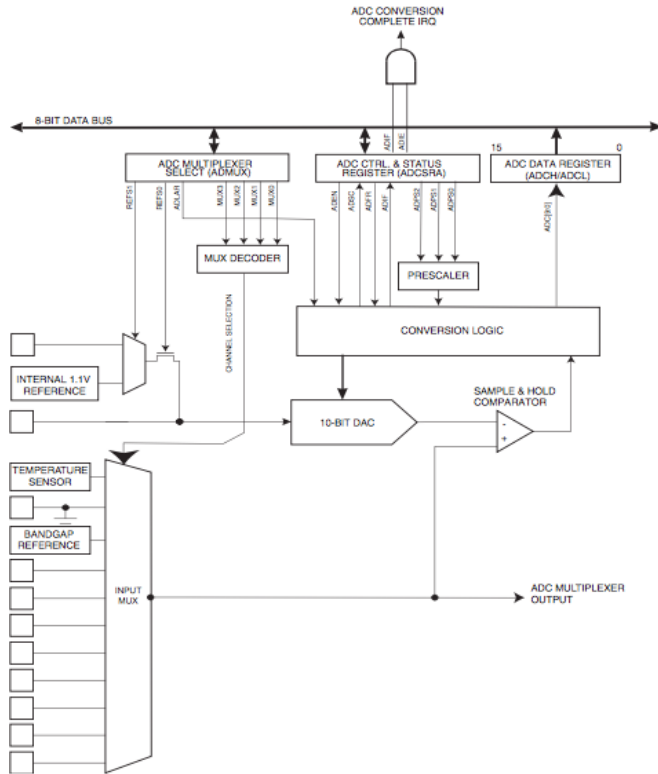
Servo electrical interface



- 1-2 ms pulse width
- 50 Hz pulse frequency
- 1.5 ms is middle



10-bit successive approximation ADC



Features

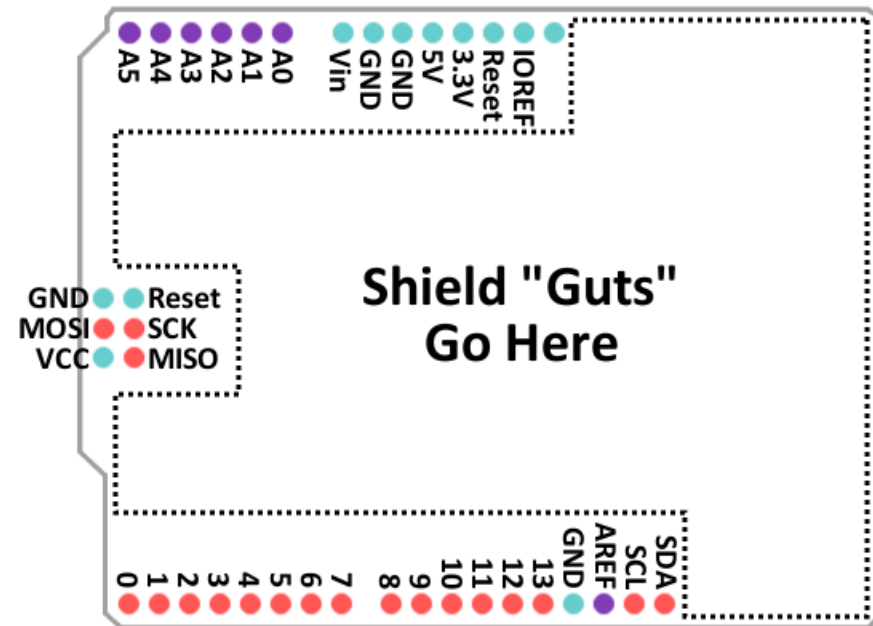
- **10-bit Resolution**
- **0.5 LSB Integral Non-linearity**
- **± 2 LSB Absolute Accuracy**
- **13 - 260 μ s Conversion Time**
- **Up to 76.9kSPS (Up to 15kSPS at Maximum Resolution)**



Shields



- “shields” are daughterboards to Arduino.
- Uses the connections along the edge
- Exists in hundreds of variants

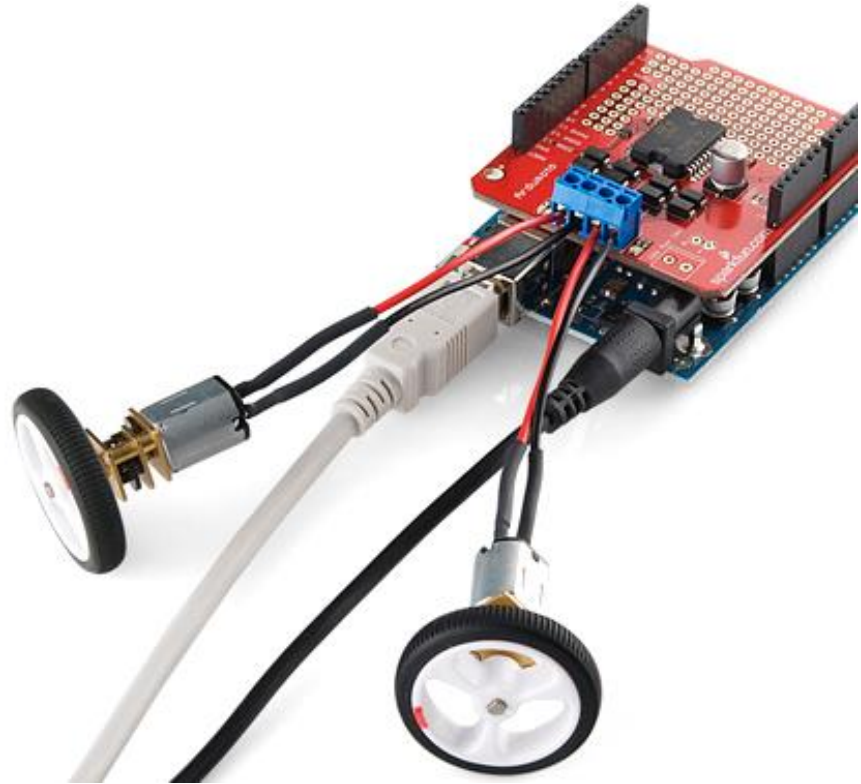


Shields



Motors and control

- Multiple variants available
 - DC motors
 - Servos
 - Stepper motors



Fritzing

Welcome Breadboard Schematic PCB Code

Parts
Core Parts
CORE Basic
MINE
Input
Output
Inspector

In this example, potentiometer values are read in through an 'Analog In' pin. The values are then used to control the position of a servo motor. Related examples: <http://arduino.cc/en/Tutorial/AnalogInput> <http://arduino.cc/en/Tutorial/Knob>

fritzing

Add a note Rotate Flip Routing completed Share

Arduino simulator: 123d.circuits.io

DESK
CIRCUITS

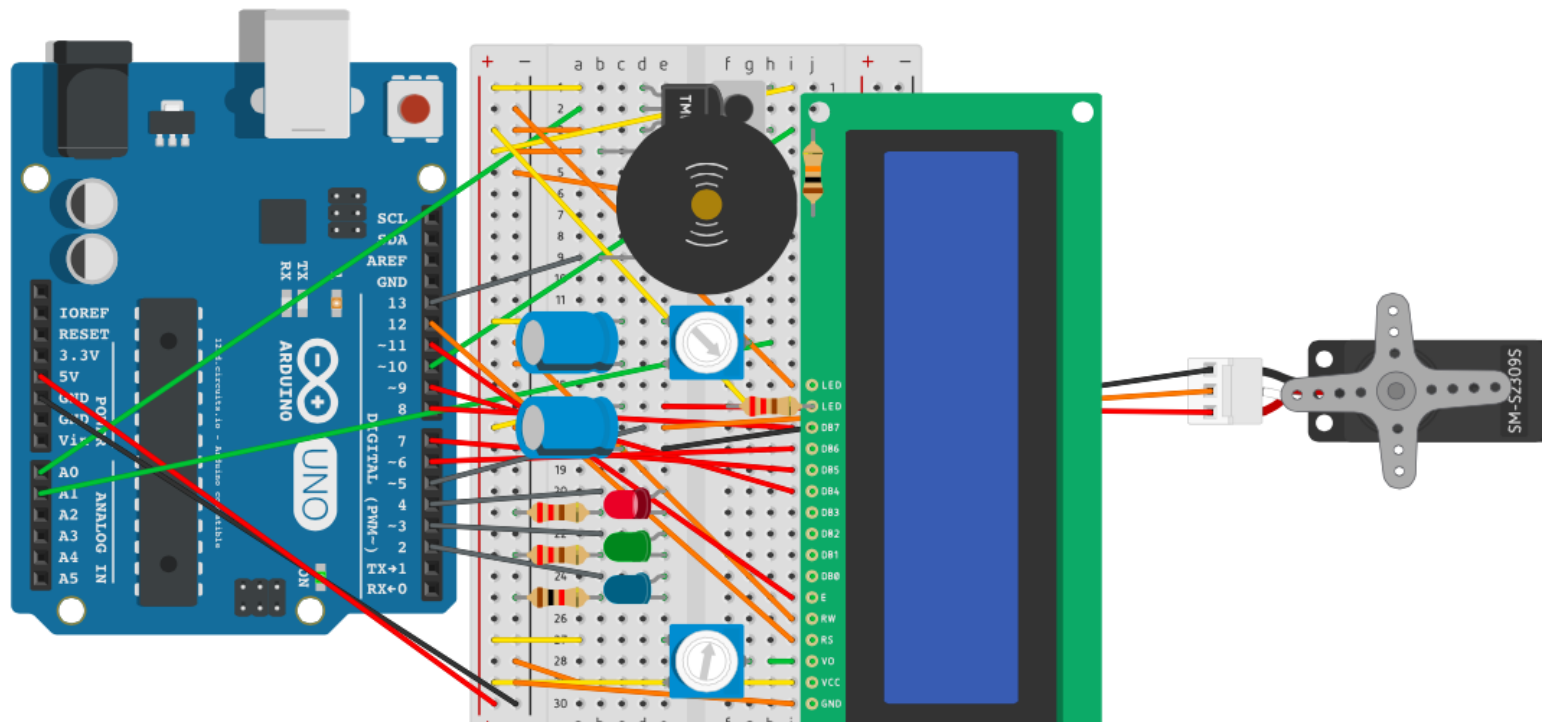


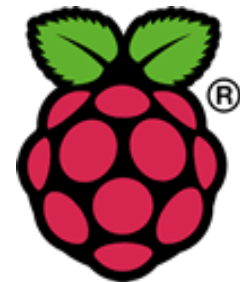
Search for designs, components or people

+ Ne

Stop Simulation

Code Editor





Raspberry Pi

Simple, cheap Linuxd computer (159:- , 329:- , 499:-)

More powerful than Arduino, and thus more complicated.

Typically programmed in Python.

Video and HDMI-utgång.

Possibility to easily connect electronics and camera



Webb-adresses

Most important:

- arduino.cc

Webb-learning:

- learn.adafruit.com
- learn.sparkfun.com

Development environments:

- processing.org
- fritzing.org
- 123d.circuits.io

Inspiration:

- Google.com
- adafruit.com
- sparkfun.com

Swedish resellers:

- electrokit.se
- lawicel.se
- elfa.se
- farnell.se





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