UNIVERSITÀ DEGLI STUDI DELLA CAMPANIA
LUIGI VANVITELLI
SCUOLA POLITECNICA E DELLE SCIENZE DI BASE
DIPARTIMENTO DI INGEGNERIA
INDUSTRIALE E DELL'INFORMAZIONE

Introduzione ai Sistemi Embedded e Arduino

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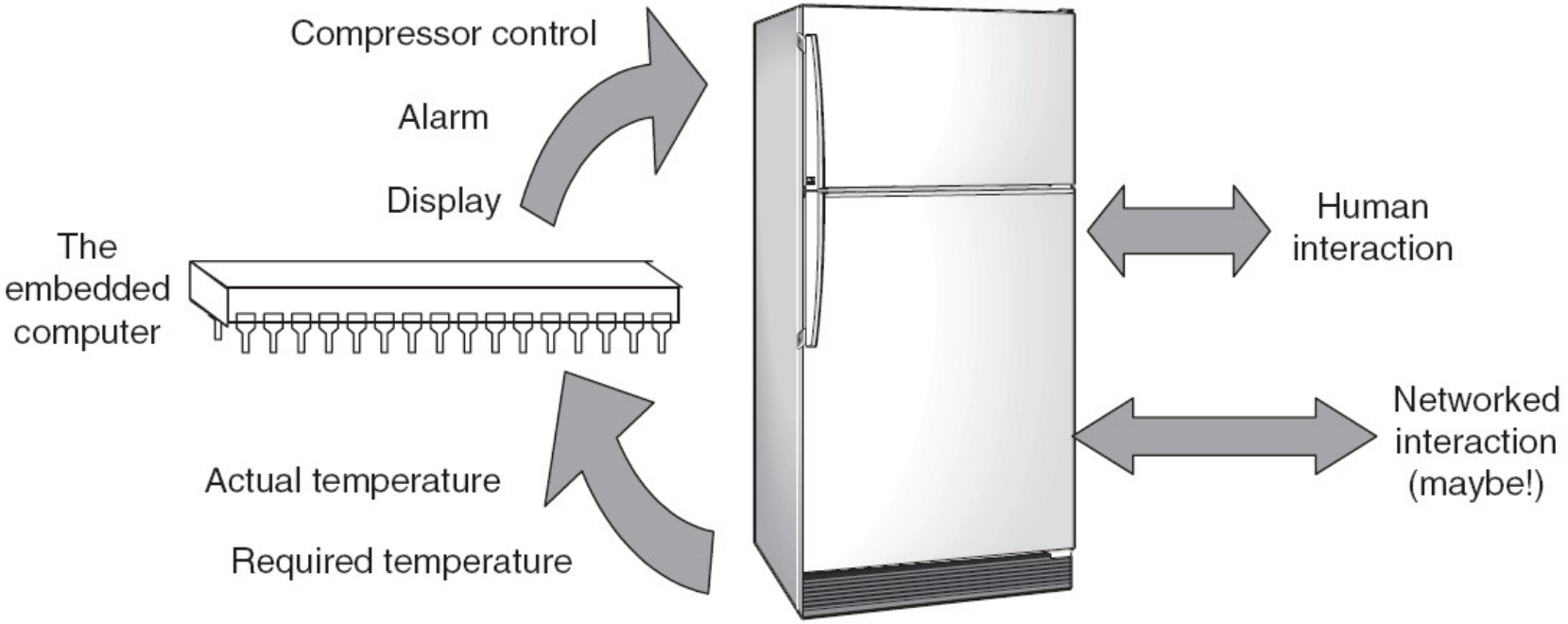
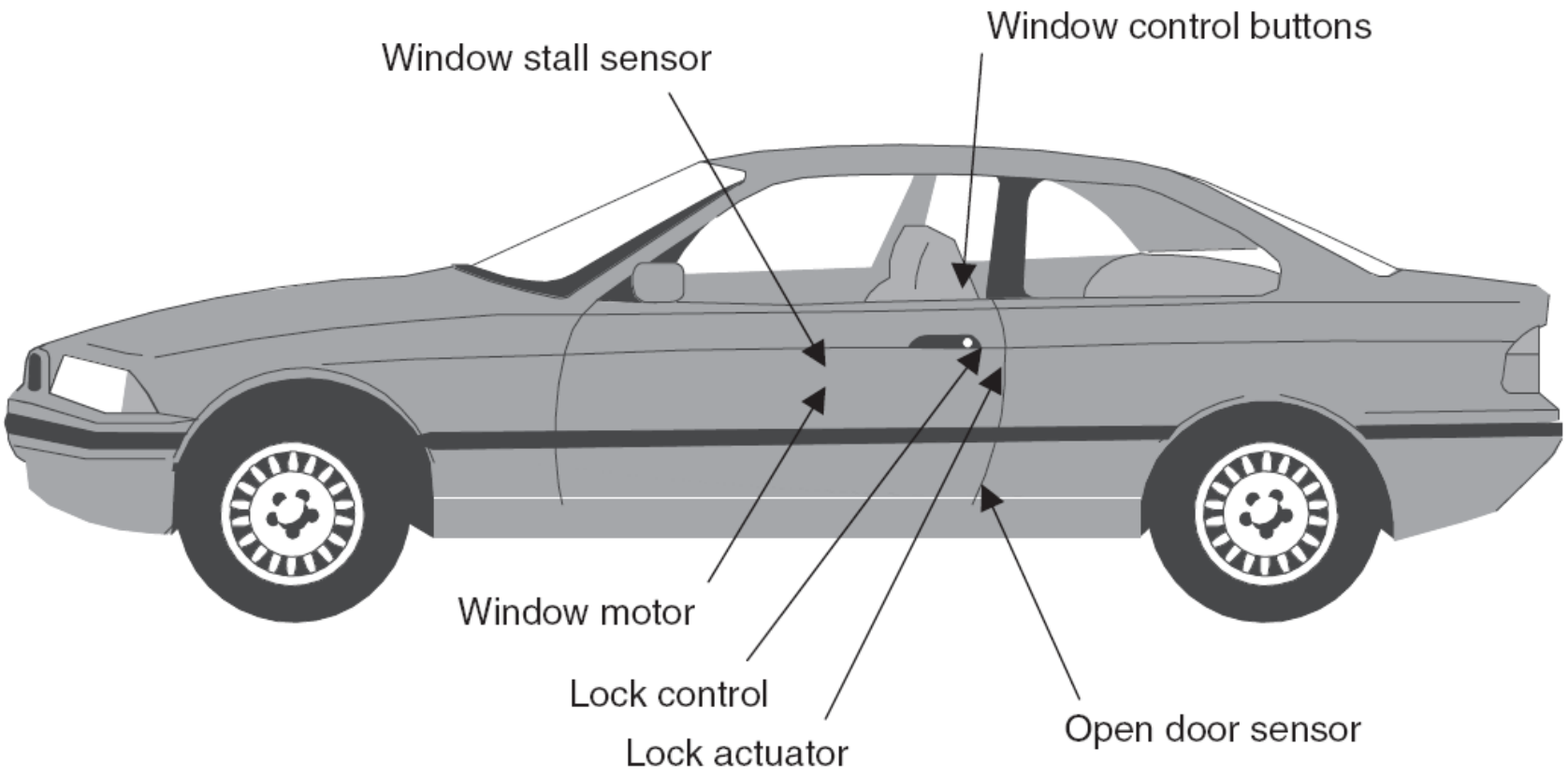
Definizione

- **Un Sistema Embedded** :
  - È un sistema la cui funzione principale non è il calcolo,
  - Ma che è controllato da un computer che è tuttuno con esso.

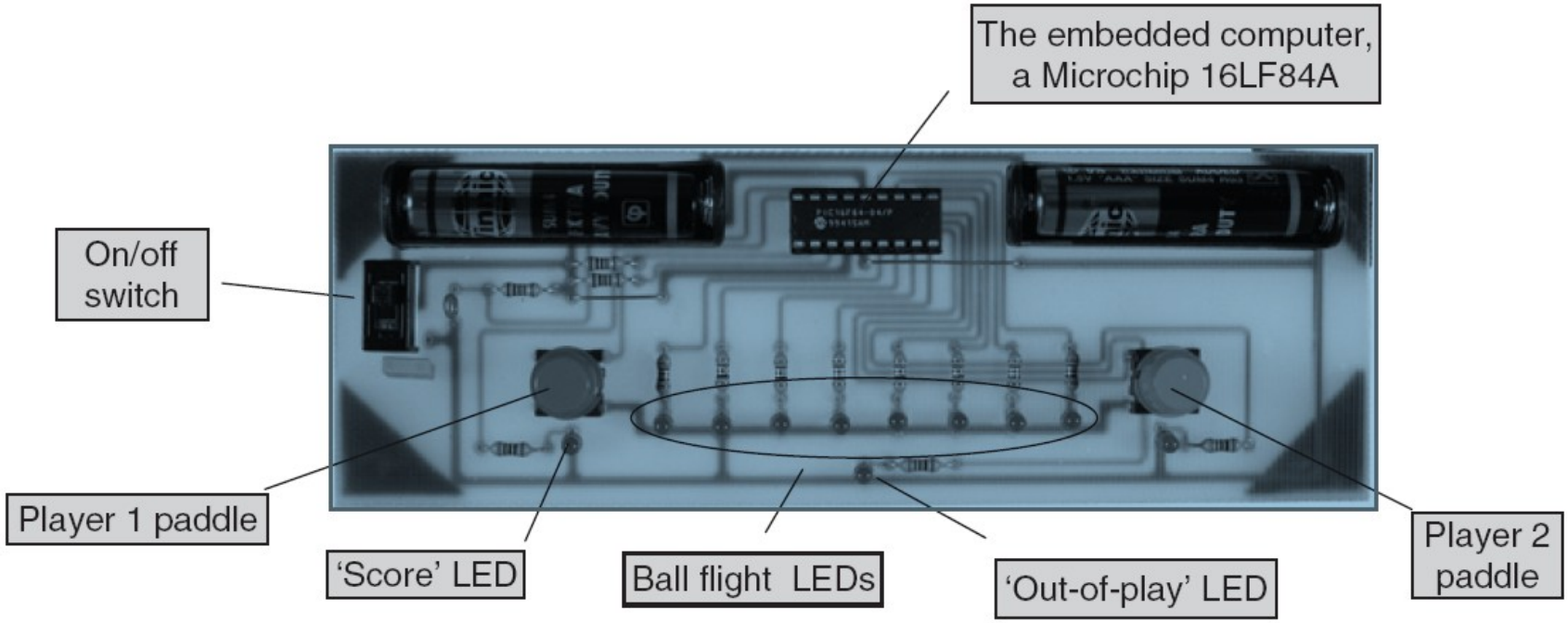
Esempio: Frigorifero



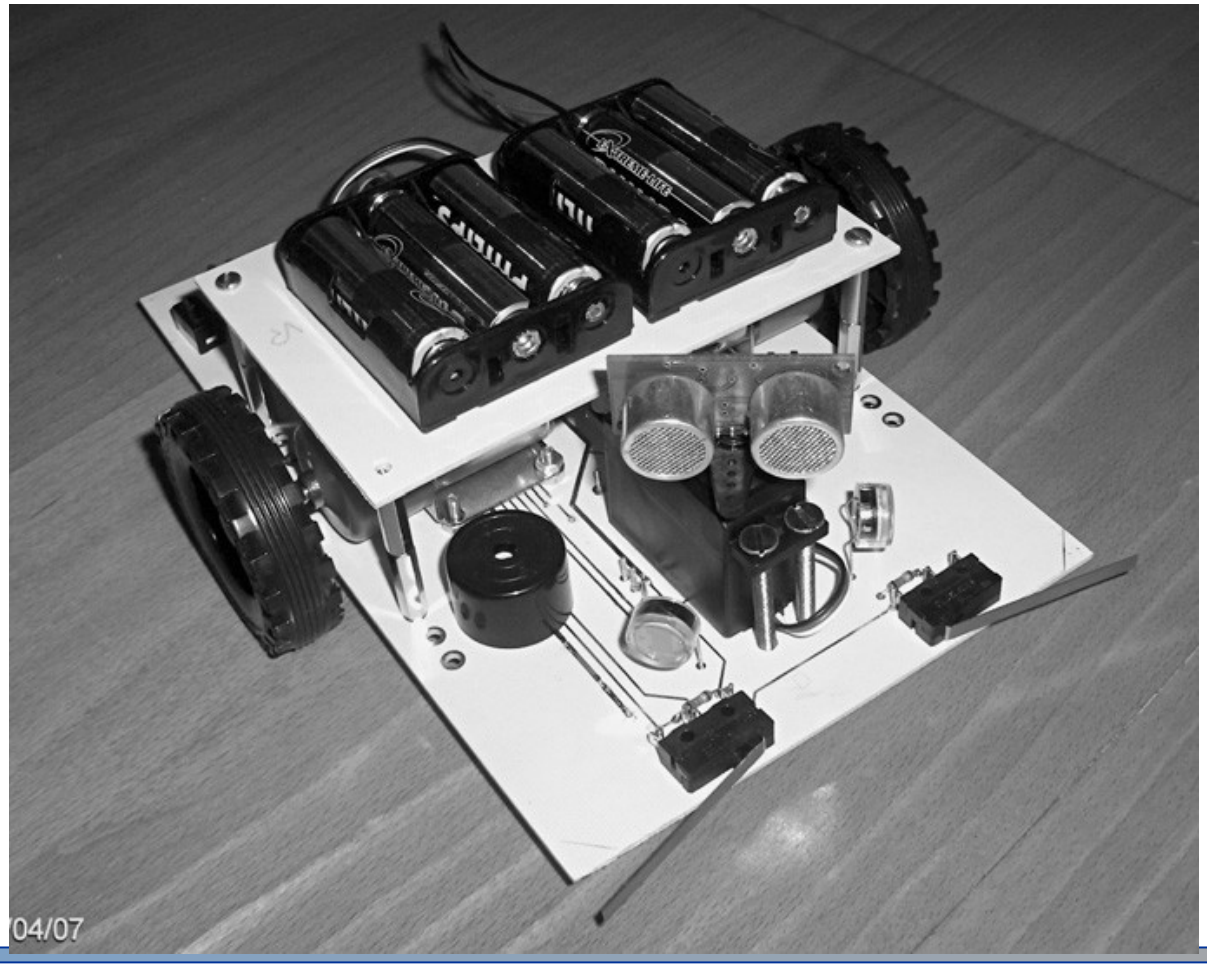
Esempio: Automobile



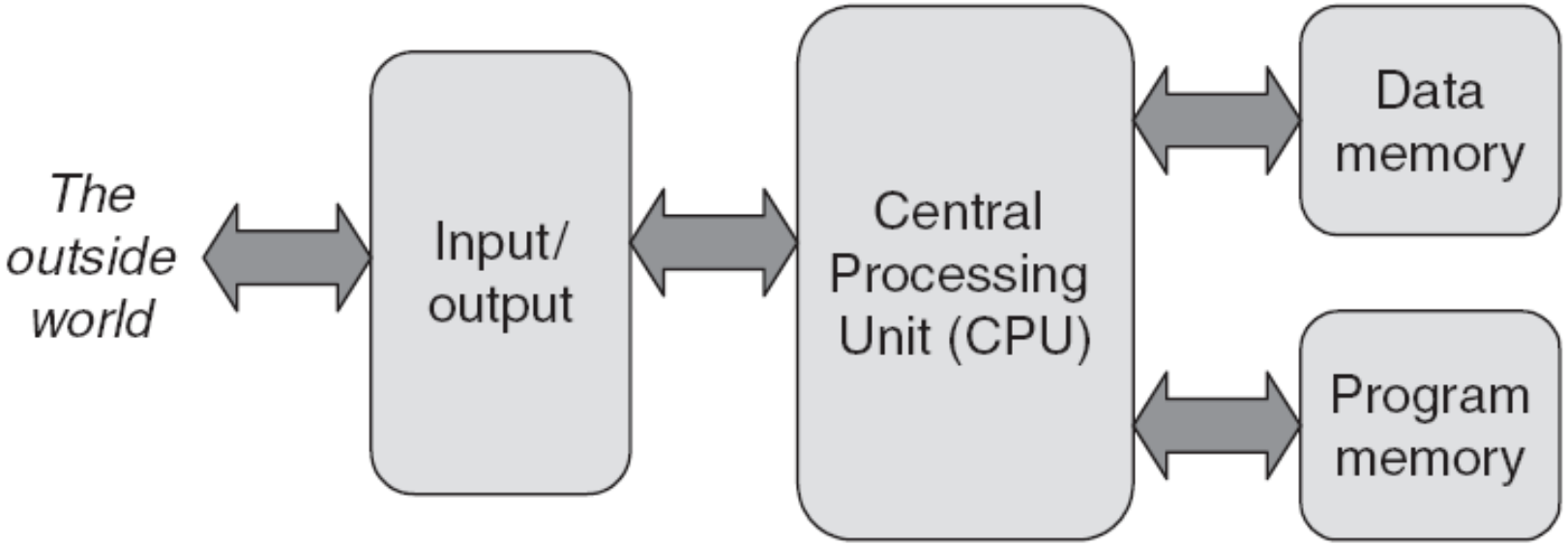
Ping Pong Elettronico



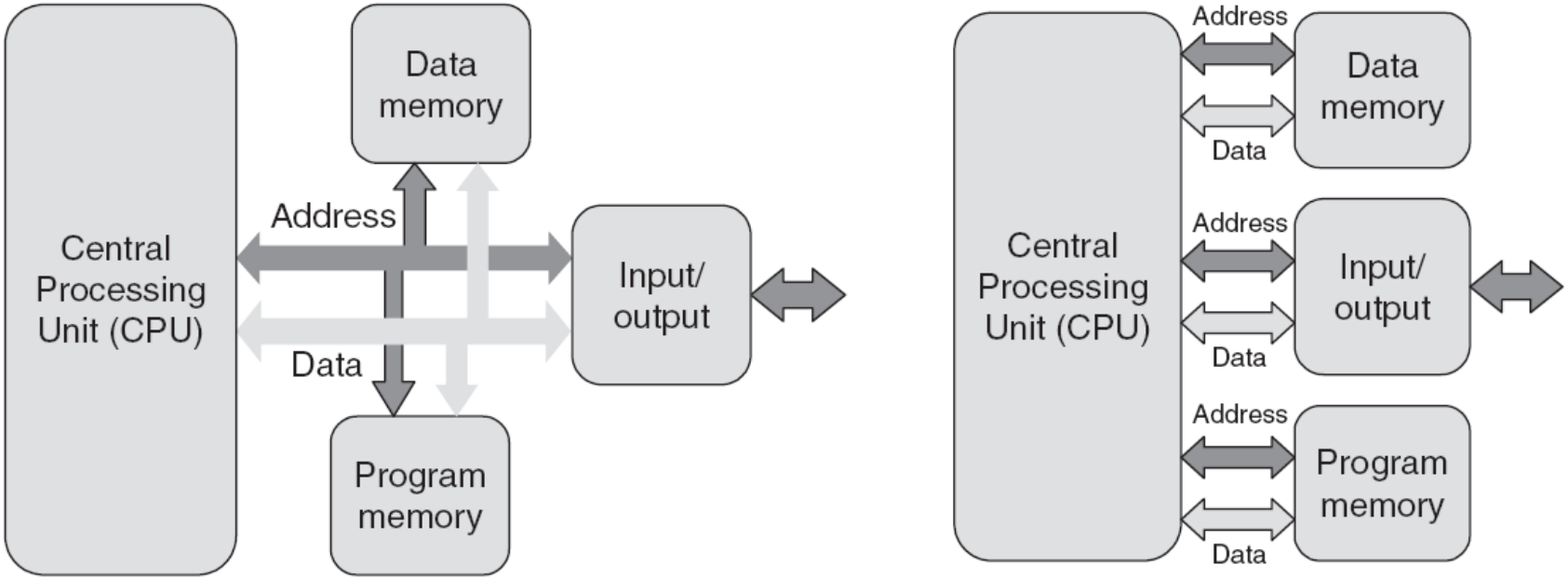
Veicolo Autonomo



Architettura Hardware



Von Neumann e Harvard Computers

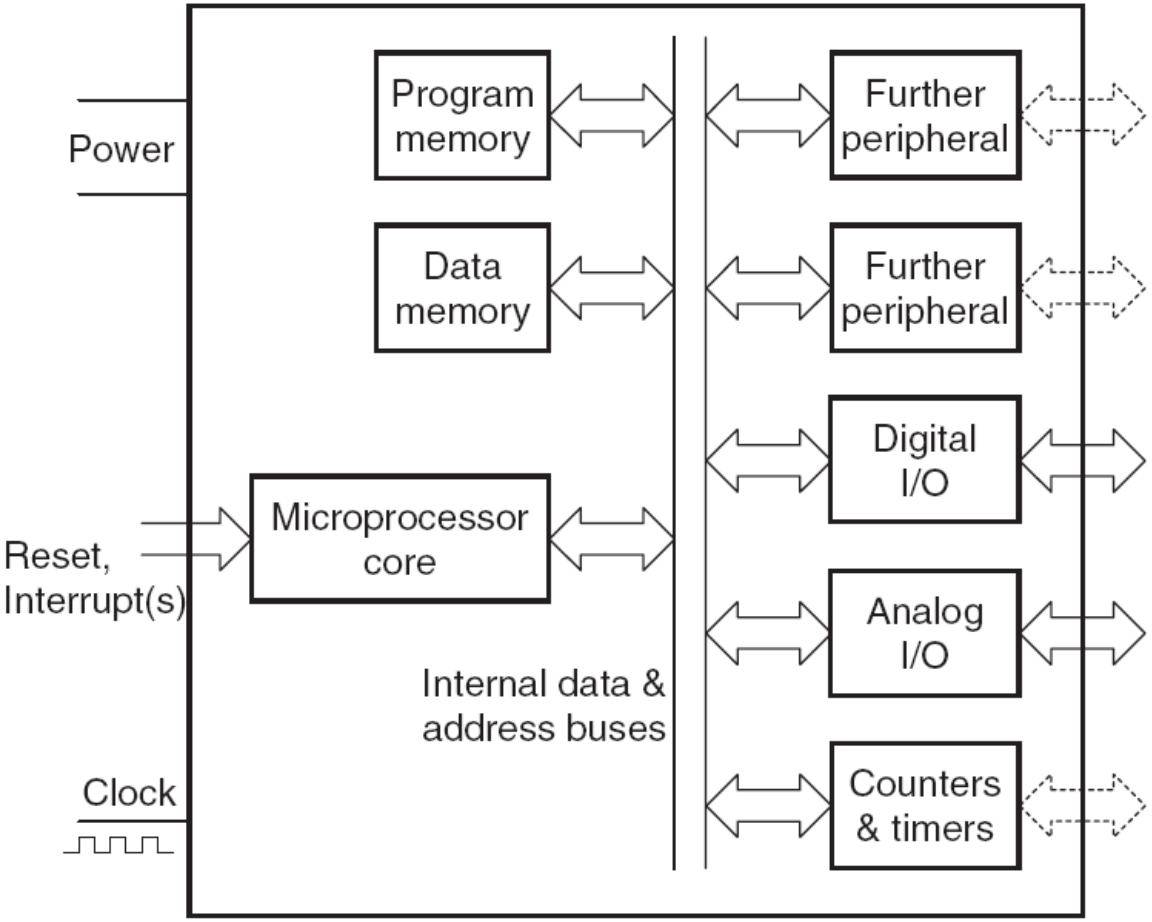


Microprocessori e Microcontrollori

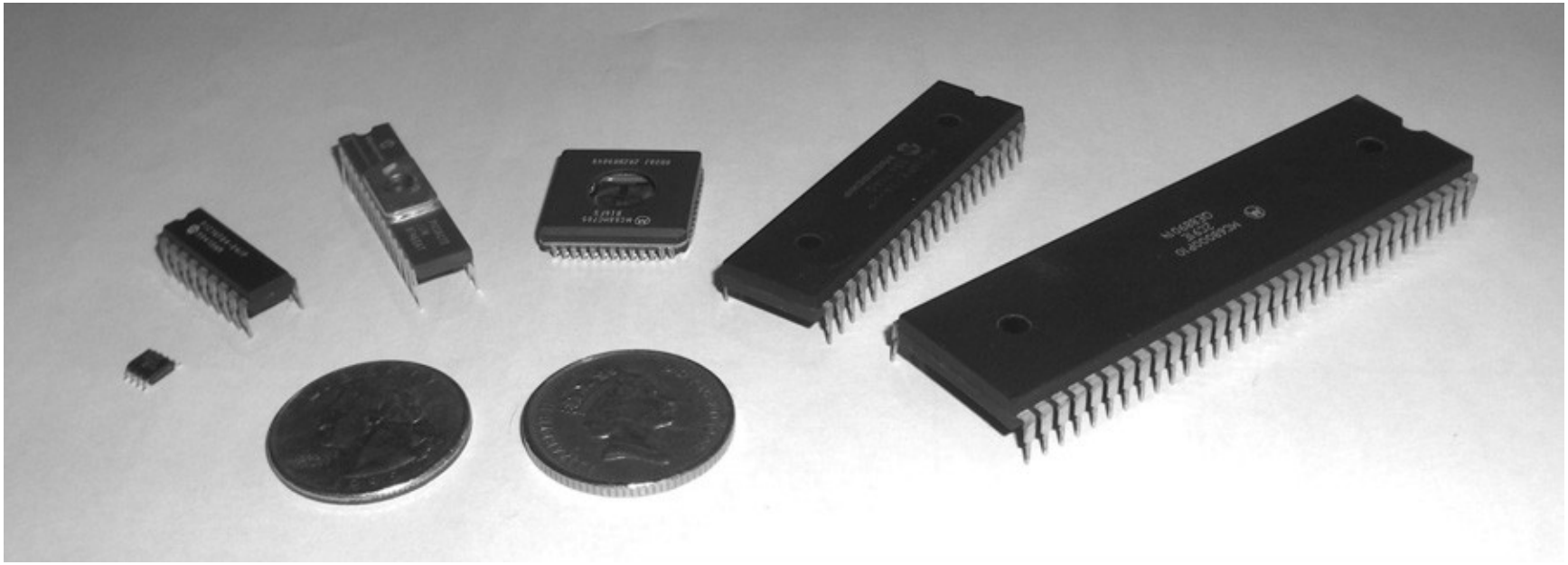
- Il microprocessore è un processore integrato in un unico chip di silicio.

- I microcontrollori sono utilizzati per la realizaione di sistemi embedded.
- Il microcontrollore è un microprocessore con periferiche integrate.

Microcontrollore



Packaging

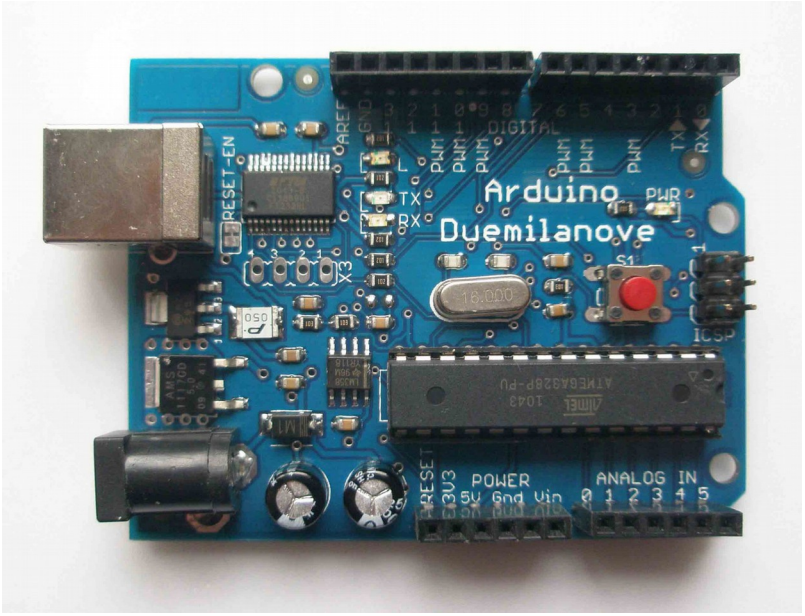


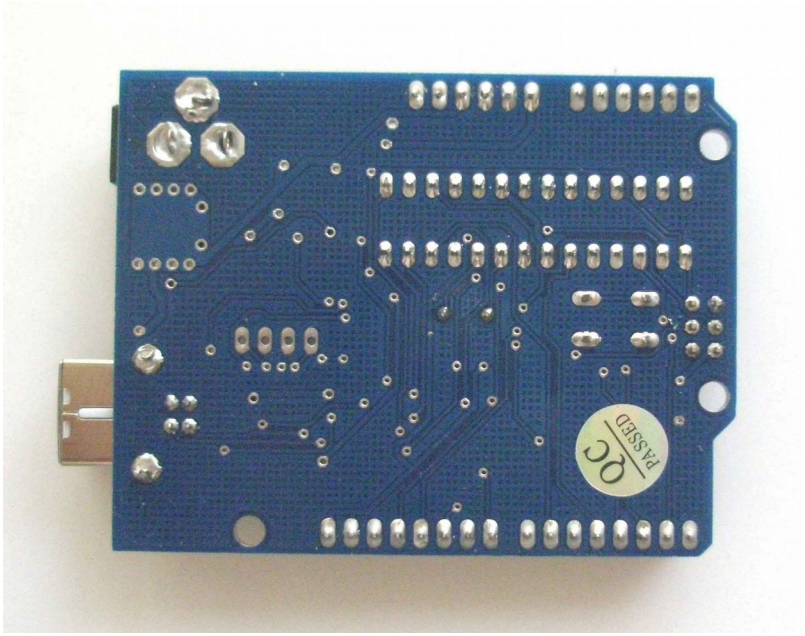
Da sinistra a destra: PIC 12F508, PIC 16F84A, PIC 16C72, Motorola 68HC05B16, PIC 16F877, Motorola 68000

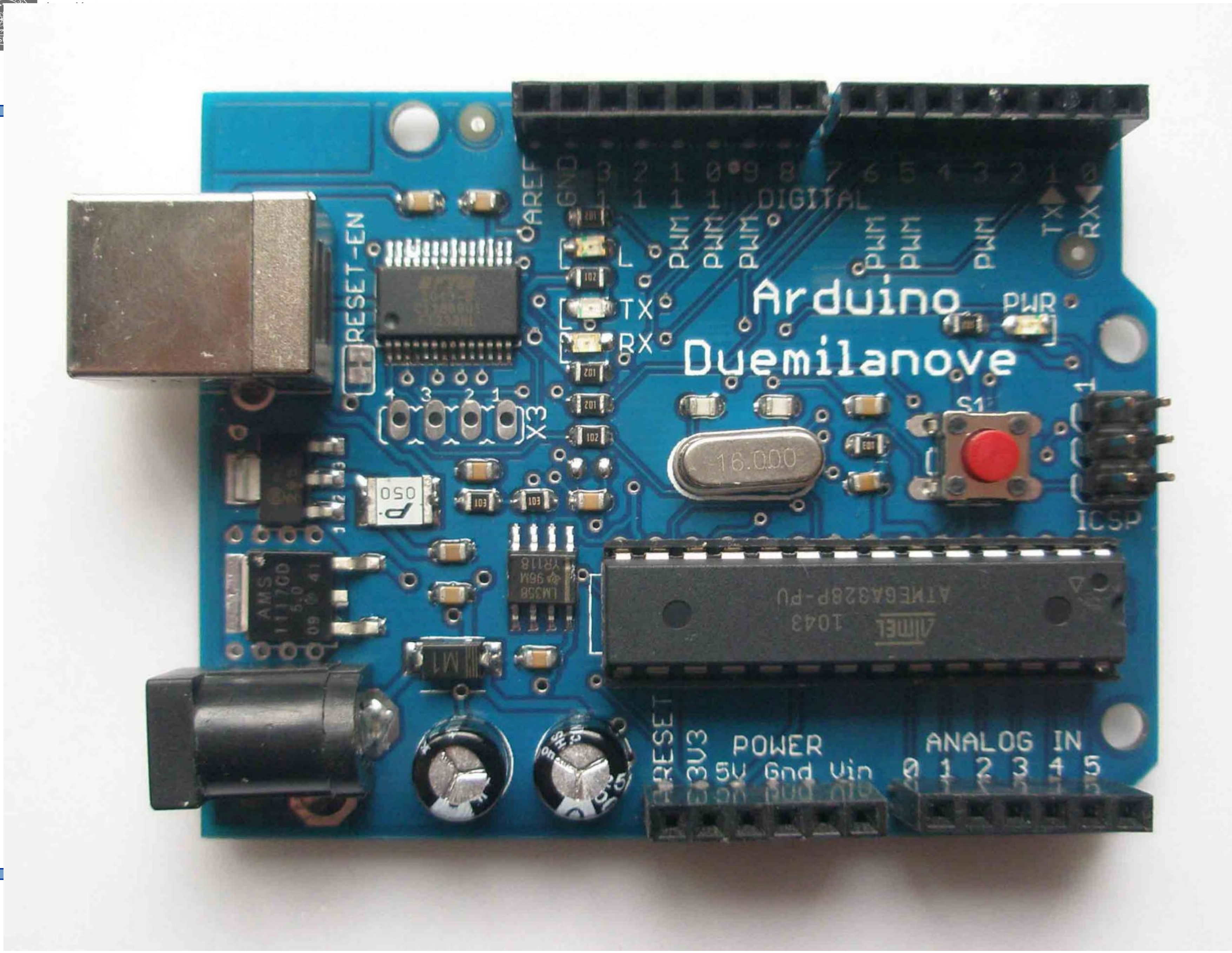
Arduino

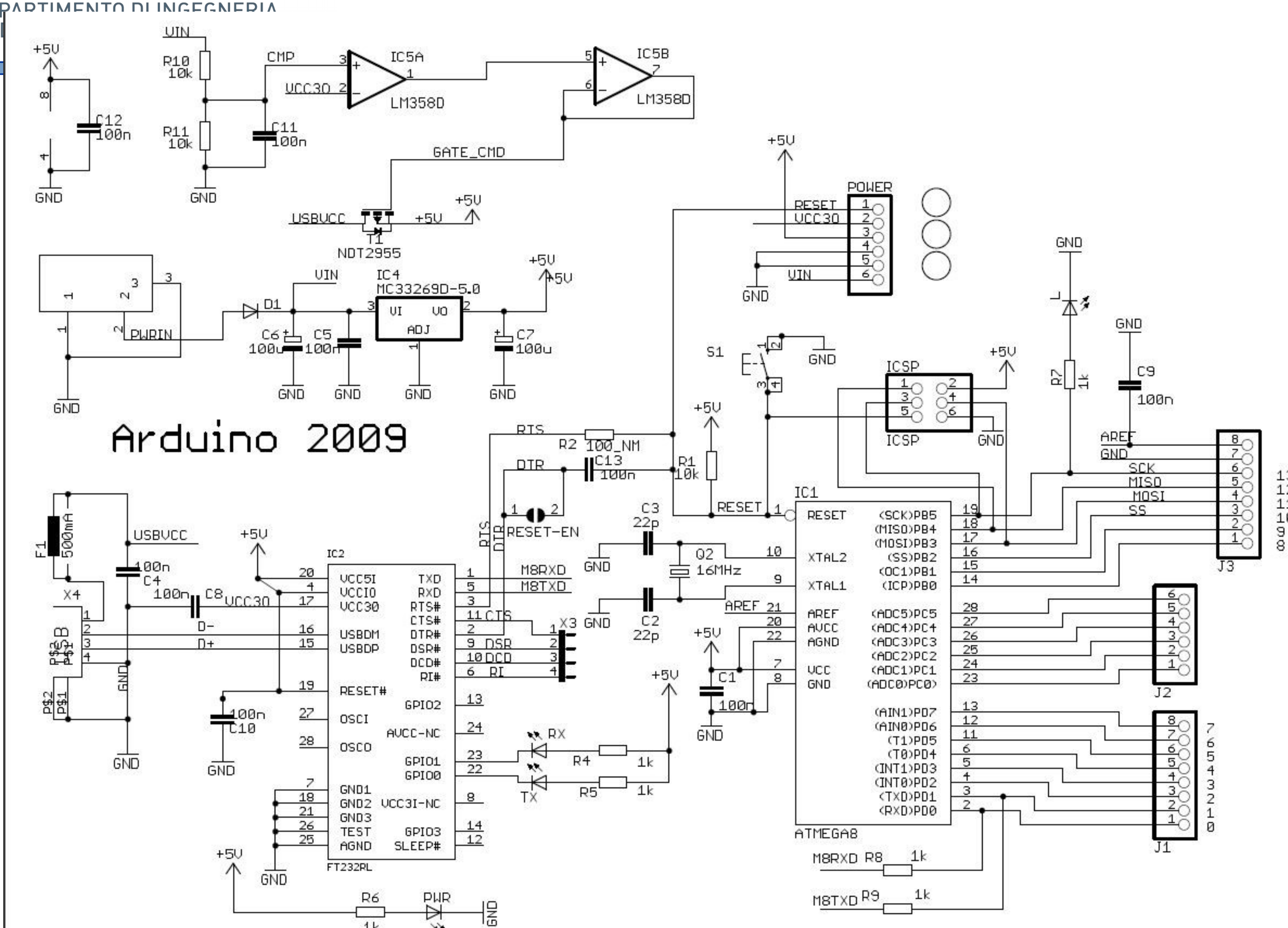
- Open Source Hardware, schema circuitale disponibile.
- Economico.
- Open Source Software.
- Diffuso con diversi progetti disponibili.
- Extra HW Disponibile.

Arduino Duemilanove (2009)

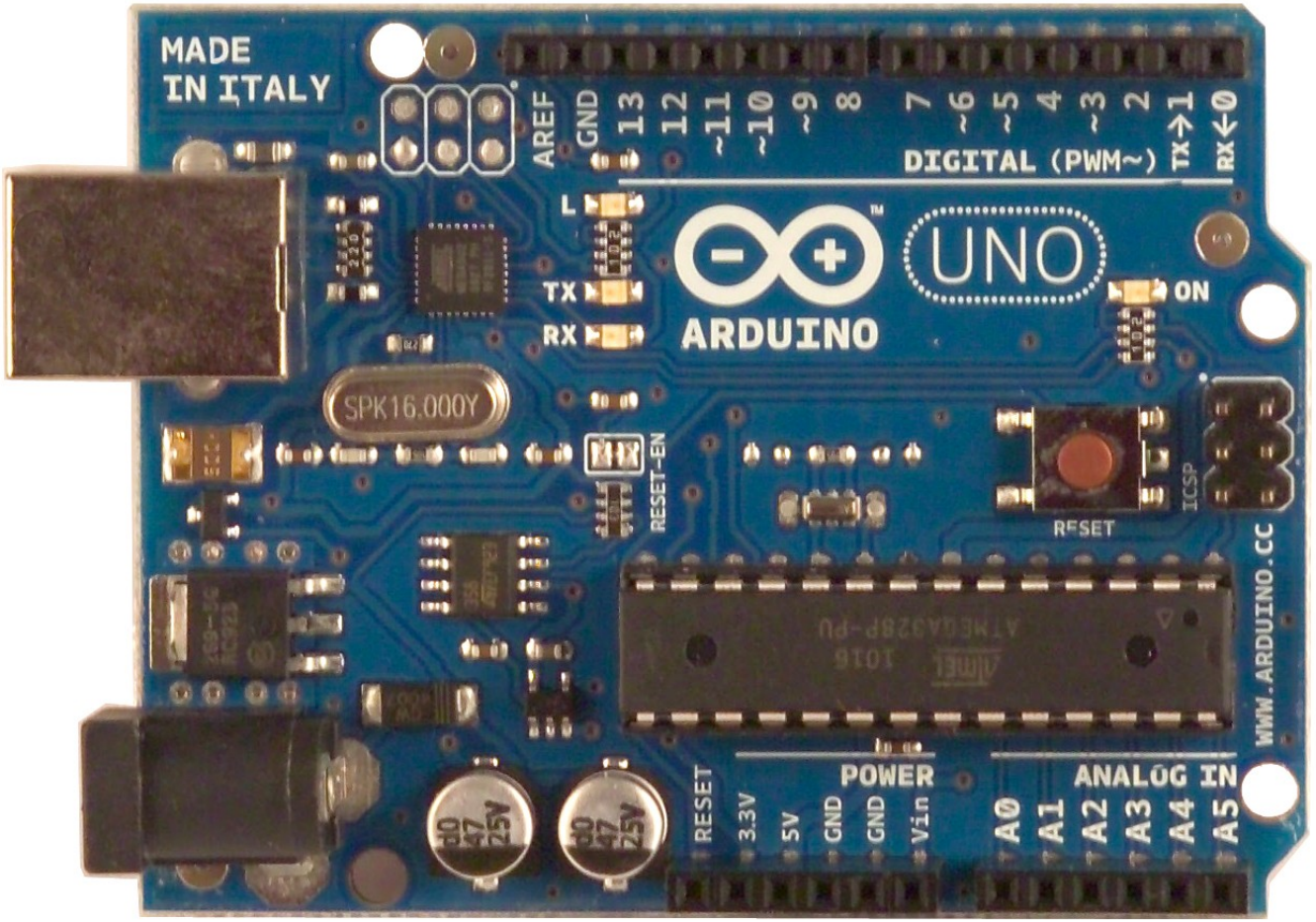




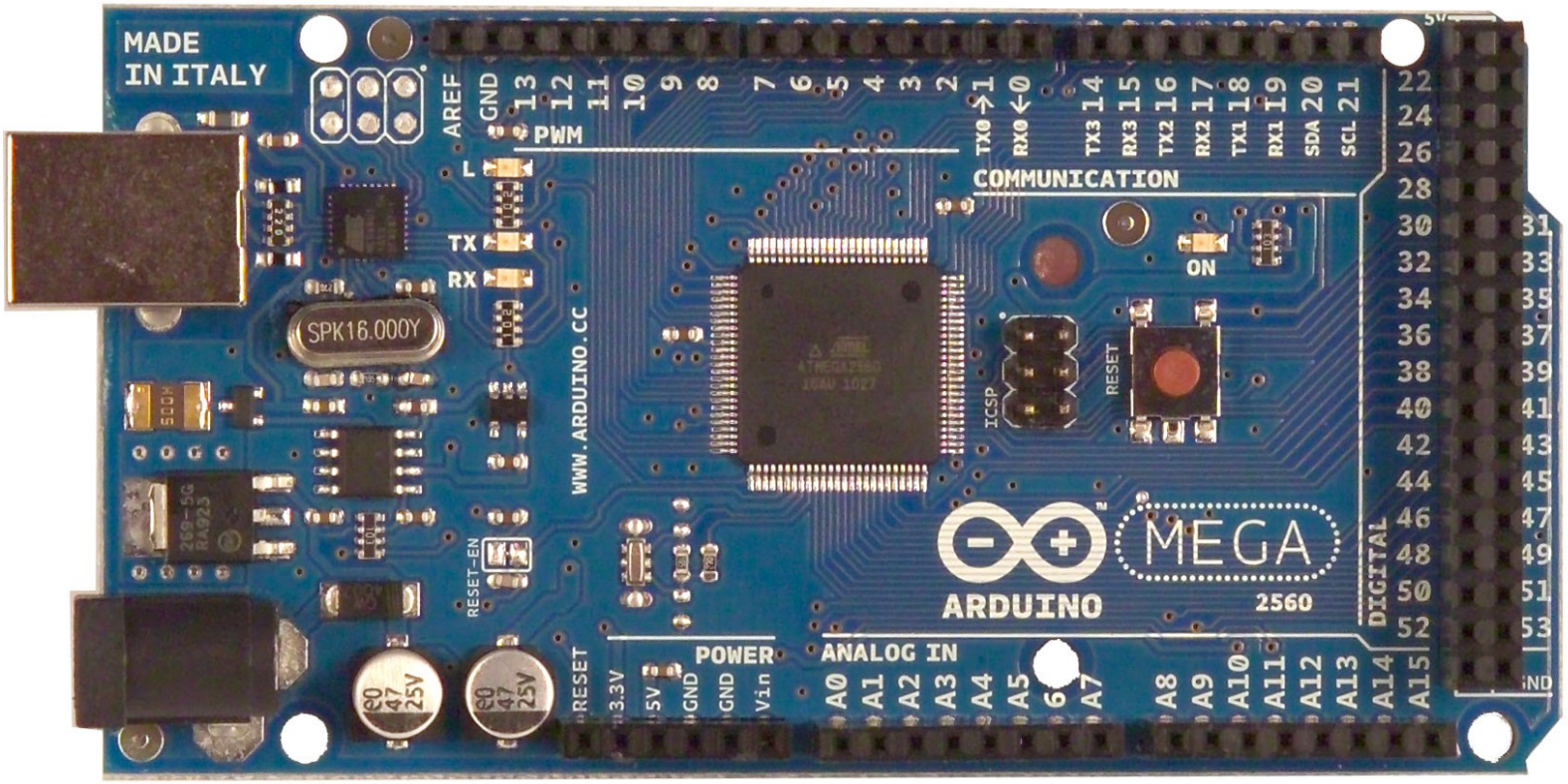

Arduino
Duemilanove
DIGITAL
AREF
GND
PWM
TX
RX
L
PWR
RESET-EN
S1
ICSP
X3
16.000
ATMEGA328P-PU
1043
AMS
1117CD
5.0
LM358
M1
RESET
3V3
POWER
5V
Gnd
Vin
ANALOG IN
0 1 2 3 4 5


Arduino 2009
IC5A
IC5B
LM358D
CMP
VCC3O
GATE_CMD
R10 10k
R11 10k
C11 100n
C12 100n
USBVCC
T1
NDT2955
IC4
MC33269D-5.0
D1
PWRIN
VIN
C6 100u
C5 100n
C7 100u
POWER
RESET
ICSP
S1
R7 1k
C9 100n
AREF
SCK
MISO
MOSI
SS
J3
J2
J1
IC1
ATMEGA8
XTAL2
XTAL1
AVCC
AGND
VCC
GND
Q2 16MHz
C3 22p
C2 22p
C1 100n
R1 10k
R2 100_NM
C13 100n
RTS
DTR
RESET-EN
F1 500mA
X4
USB
C4 100n
C8 100n
C10 100n
IC2
FT232RL
VCC5I
VCCIO
USBDM
USBDP
RESET#
OSCI
OSCO
TEST
TXD
RXD
RTS#
CTS#
DTR#
DSR#
DCD#
RI#
GPIO2
AVCC-NC
GPIO1
GPIO0
VCC3I-NC
GPIO3
SLEEP#
X3
M8RXD
M8TXD
RX
TX
R4 1k
R5 1k
R6 1k
PWR
R8 1k
R9 1k
+5V

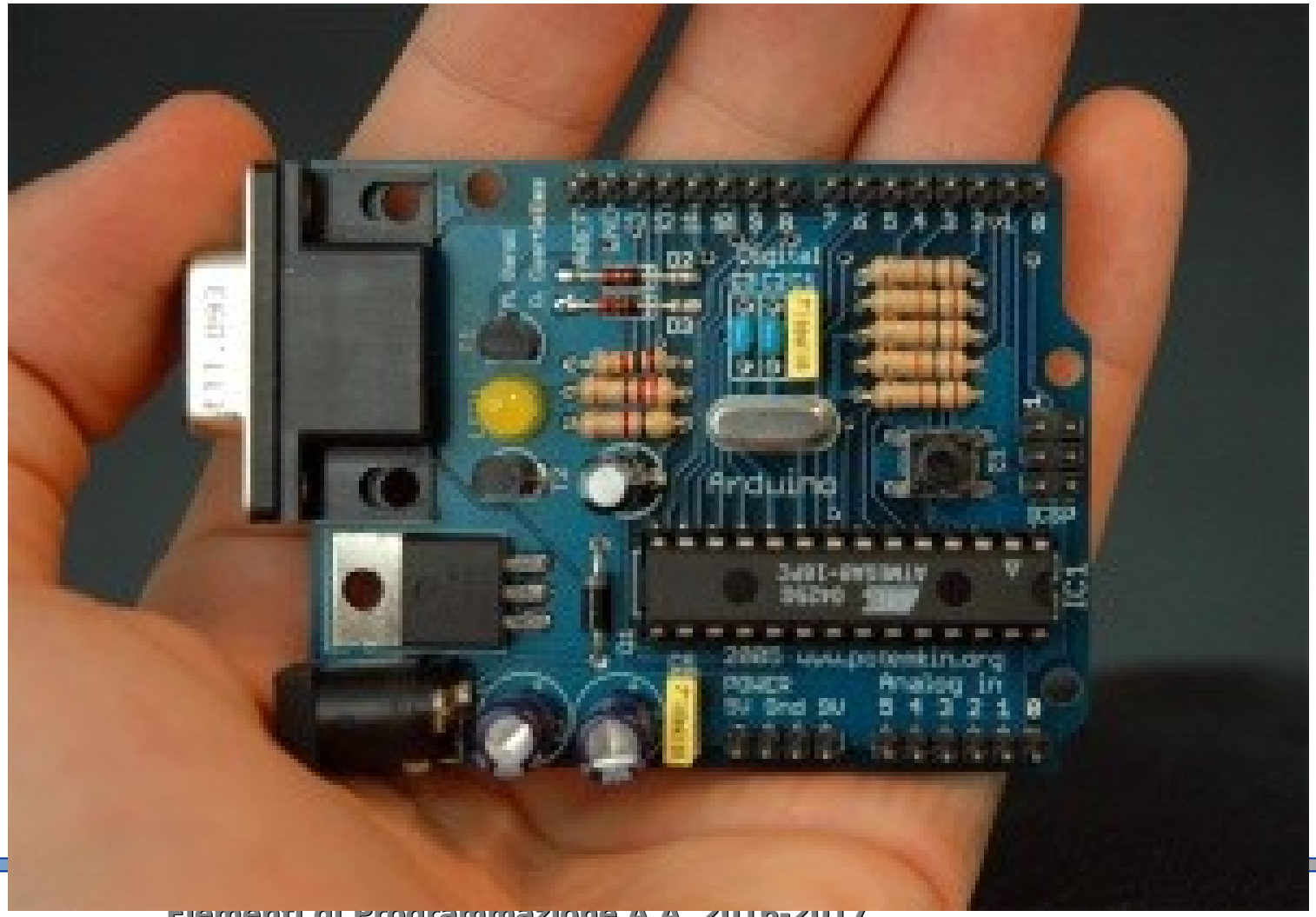
Arduino Uno


MADE
IN ITALY
AREF
GND
13
12
~11
~10
~9
8
7
~6
~5
4
~3
2
TX→1
RX←0
DIGITAL (PWM~)
L
TX
RX
ARDUINO
UNO
ON
SPK16.000Y
RESET-EN
RESET
ICSP
WWW.ARDUINO.CC
POWER
ANALOG IN
RESET
3.3V
5V
GND
GND
Vin
A0
A1
A2
A3
A4
A5

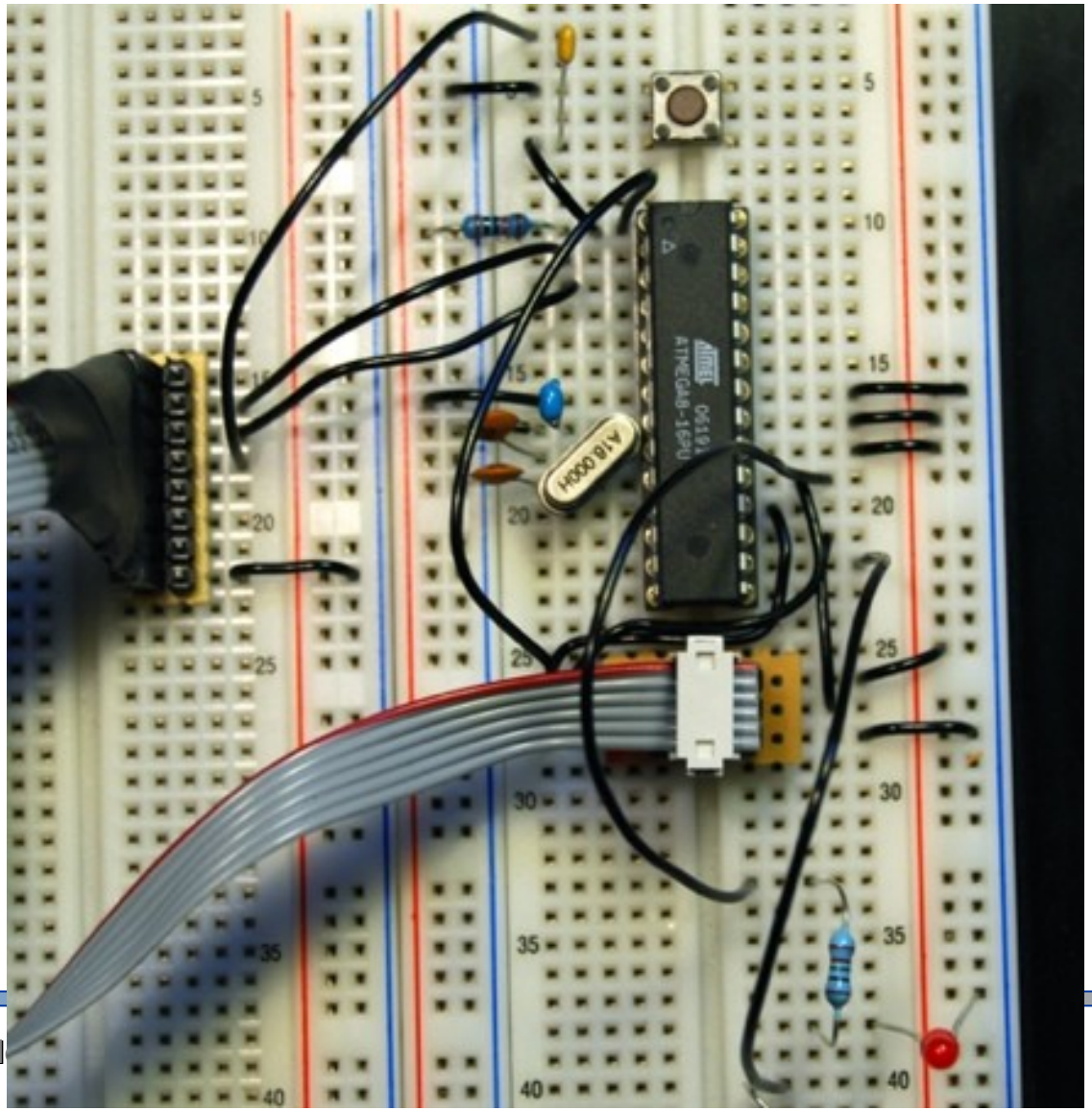
Arduino Mega 2560



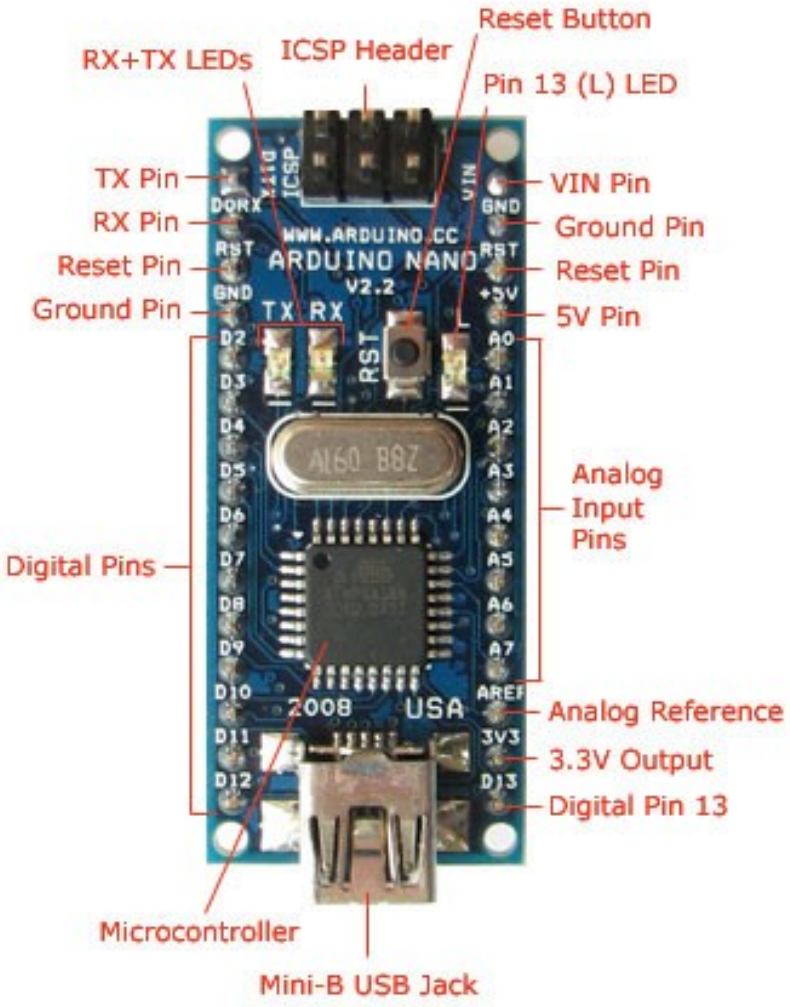
Original Arduino with RS-232

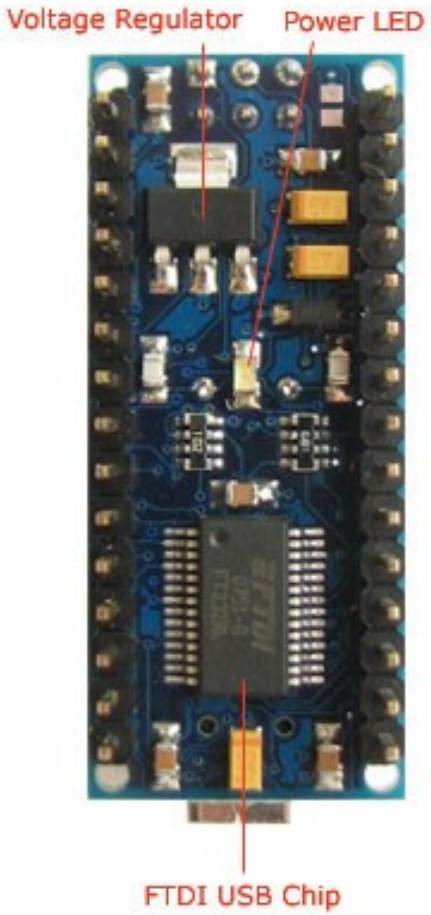


Arduino on breadboard

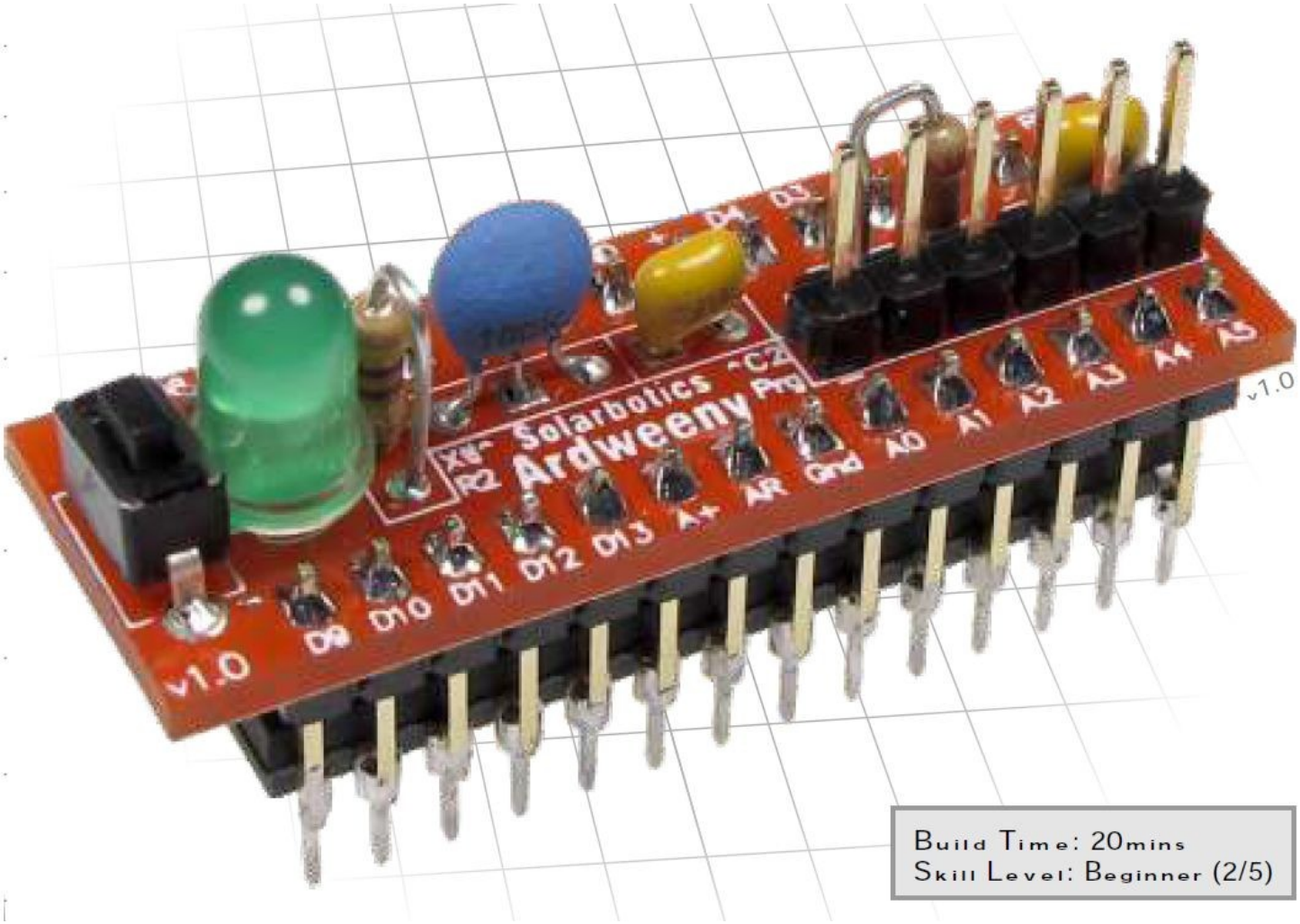


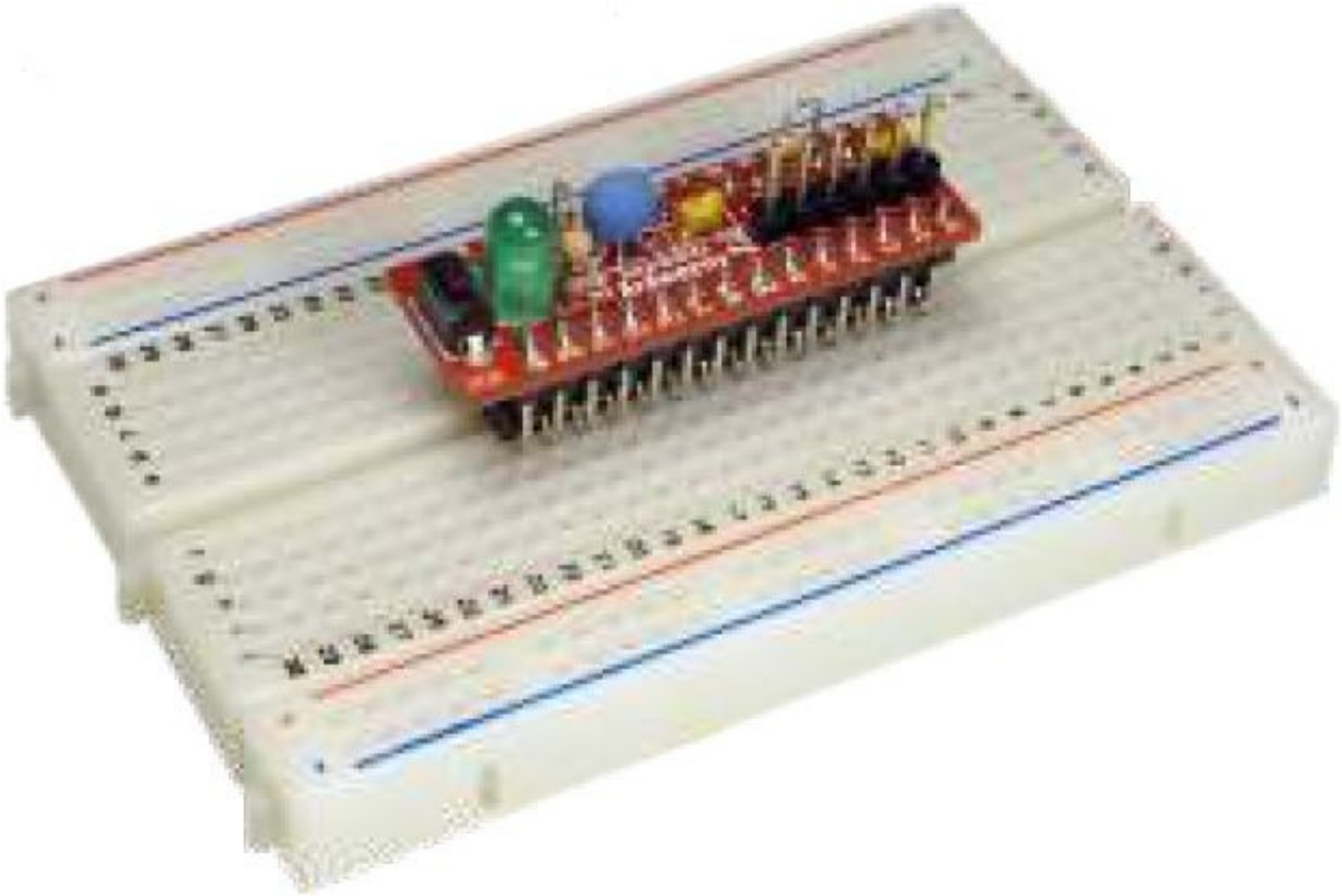
Arduino Nano



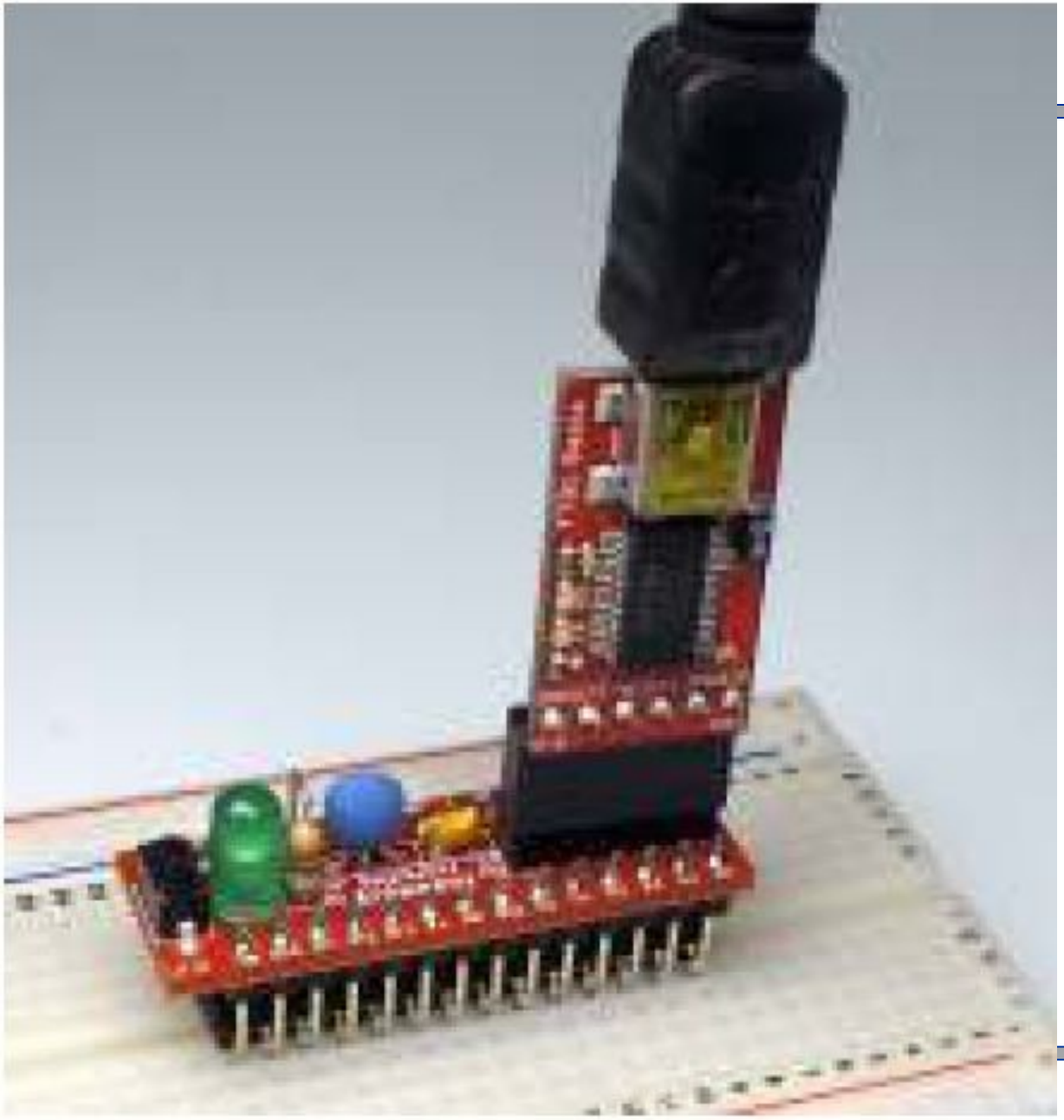


Ardweeny

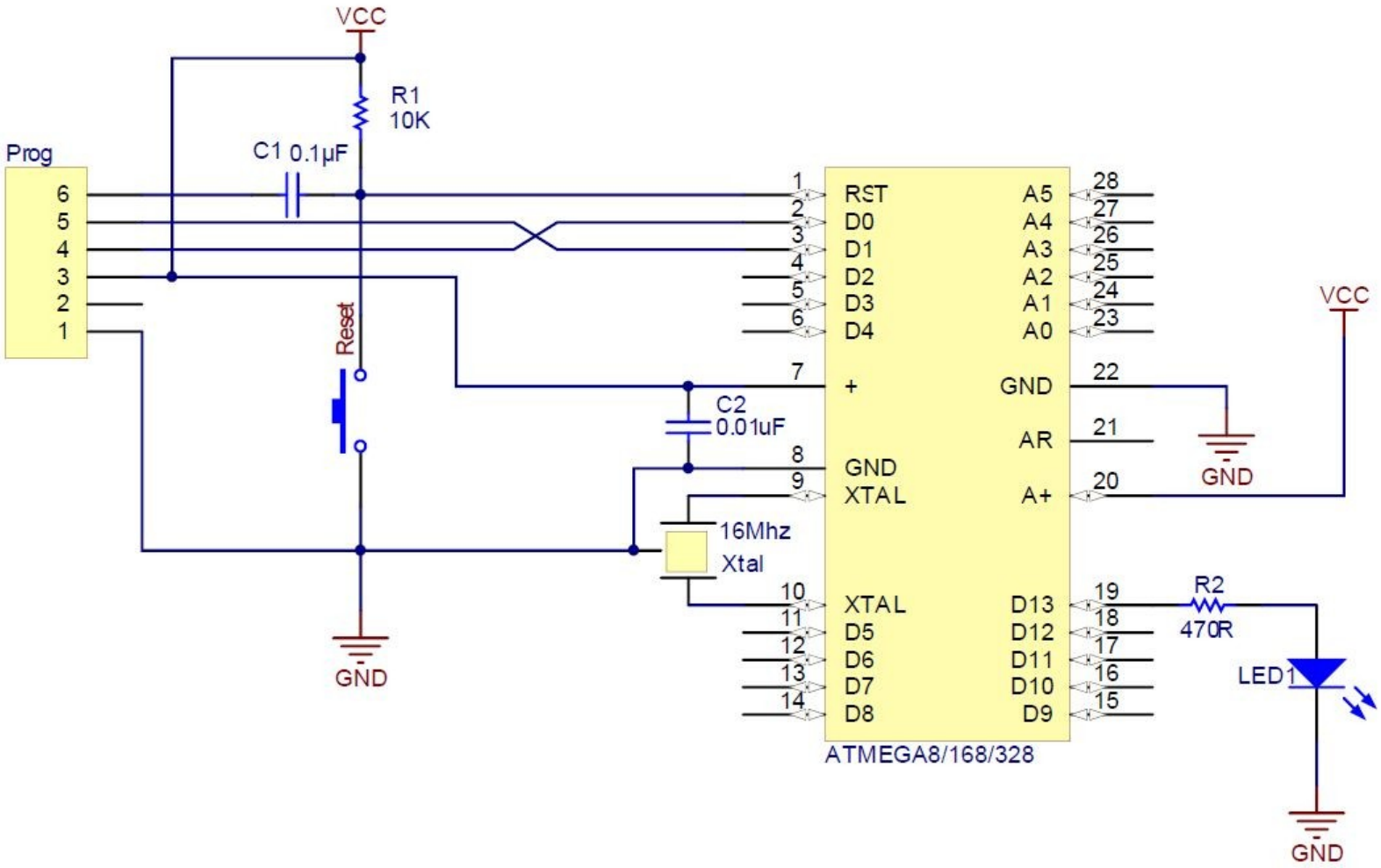

Solarbotics
Ardweeny
v1.0
Build Time: 20mins
Skill Level: Beginner (2/5)



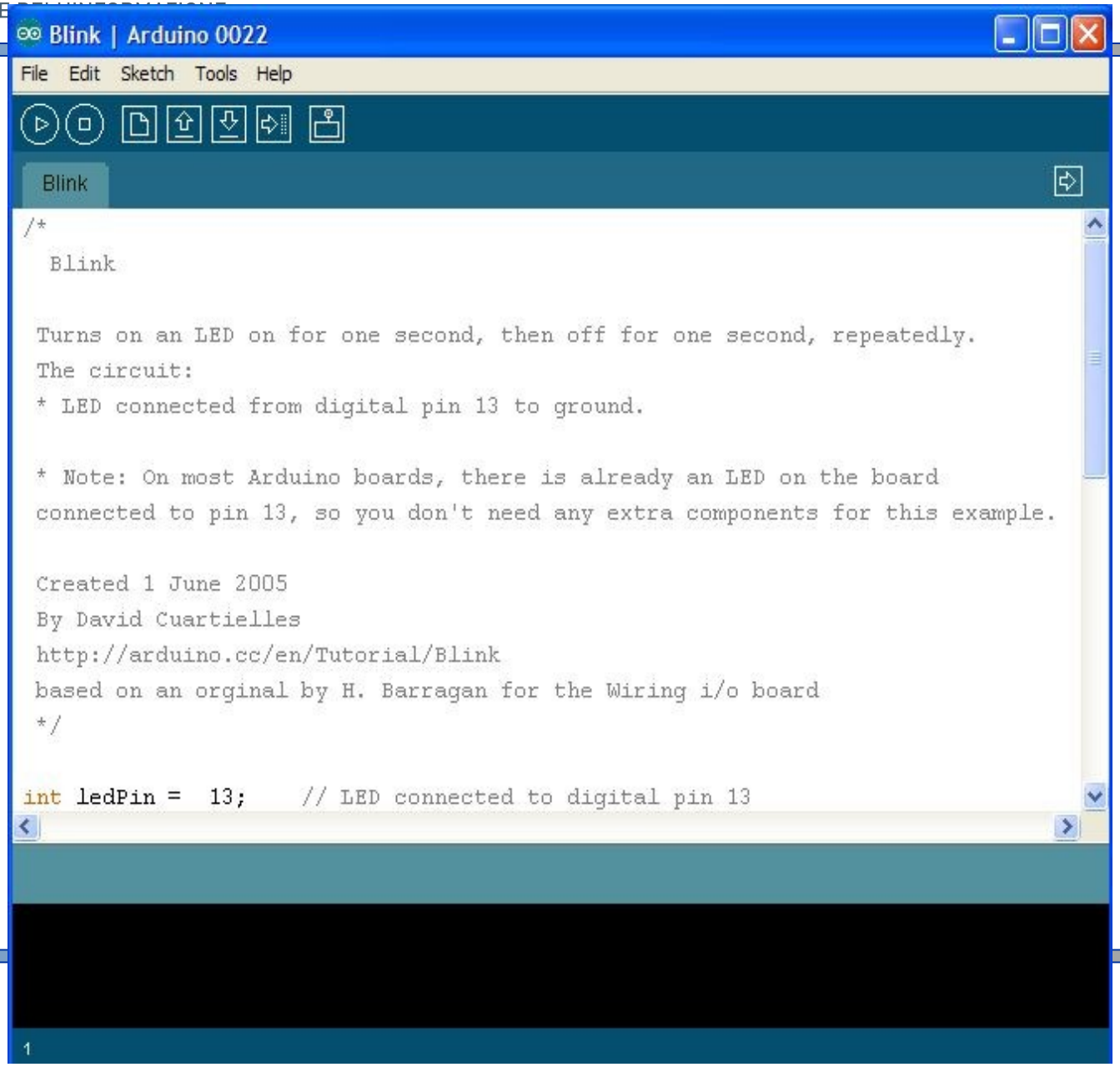
Elementi di Programmazione A.A. 2016-2017



Ardweeny 1.0 Schematic



Arduino IDE


Blink | Arduino 0022
File Edit Sketch Tools Help
Blink
/*
Blink
Turns on an LED on for one second, then off for one second, repeatedly.
The circuit:
* LED connected from digital pin 13 to ground.
* Note: On most Arduino boards, there is already an LED on the board
connected to pin 13, so you don't need any extra components for this example.
Created 1 June 2005
By David Cuartielles
http://arduino.cc/en/Tutorial/Blink
based on an orginal by H. Barragan for the Wiring i/o board
*/
int ledPin = 13; // LED connected to digital pin 13
1

Arduino Language

- Sintassi C like, ma semplificata
- Corrispondenza numeri-pin
- Trades efficience for ease of use
- Facile da imparare ma potente
- Molti esempi già svolti
- Facile riutilizzo di codice c
- Librerie possono essere riscritte in C++
- Molte librerie disponibili in rete

```
int ledPin =  13;    // LED connected to digital pin 13

// Il metodo setup() viene richiamato una sola volta allo start
void setup()  {
  // inizializzazione del pin digital in output
  pinMode(ledPin, OUTPUT);
}
// il metodo loop() esegue continuamente,
// fintanto che arduino è acceso
loop()
{
  digitalWrite(ledPin, HIGH);   // accende il LED
  delay(500);  // aspetta mezzo secondo
  digitalWrite(ledPin, LOW);    // spegne il LED
  delay(500);   // aspetta mezzo secondo
```

Interrupt

```
const byte ledPin = 13;
const byte interruptPin = 2;
volatile byte state = LOW;

void setup() {
  pinMode(ledPin, OUTPUT);
  pinMode(interruptPin, INPUT_PULLUP);
  attachInterrupt(digitalPinToInterrupt(interruptPin), blink, CHANGE);
}

void loop() {
  digitalWrite(ledPin, state);
}

void blink() {
  state = !state;
}
```

attachInterrupt(digitalPinToInterrupt(pin), ISR, mode);

mode:

- LOW to trigger the interrupt whenever the pin is low,
- CHANGE to trigger the interrupt whenever the pin changes value
- RISING to trigger when the pin goes from low to high,
- FALLING for when the pin goes from high to low.