

Arduino

Microcontrollers Made Easy

Serge Wroclawski

February 19, 2009



This work is licensed under the *Creative Commons Attribution-ShareAlike 3.0 License*.

What is Arduino?

- ▶ Microcontroller Platform
 - ▶ Provides one standard set of assumed hardware, interfaces, etc.
- ▶ Hardware
 - ▶ Microcontroller
 - ▶ IO (USB or Serial)
 - ▶ Power
- ▶ Software
 - ▶ The Arduino Language
 - ▶ Tools to flash to Arduino

Arduino is Free/Open Source

- ▶ Programming environment is all Free Software
- ▶ The bootloader is Free Software
- ▶ The PCB board is under a Creative Commons License

What is Arduino used for?

- ▶ Input
 - ▶ Sensors
 - ▶ Digital Input (Serial, SPI, I2C)
- ▶ Output
 - ▶ LEDs
 - ▶ Displays
 - ▶ Speakers
- ▶ Control and Communication
 - ▶ Drive other machinery
 - ▶ Directly or using a communication protocol

The Arduino Hardware

Arduinos differ in design but all share some basic functionality

- ▶ AVR Microcontroller
 - ▶ Amtel AVR Mega168 or AVR Mega8 (older models)
- ▶ Power Supply
 - ▶ Either directly or via USB power
- ▶ Communications
 - ▶ Serial (older models)
 - ▶ USB (most models)
 - ▶ Connections to a USB interface (smaller models)
- ▶ Pins for various functions

The AVR Mega148

- ▶ 1 - 16Mhz CPU (20 MIPS)
- ▶ 1Kb SRAM
- ▶ 16Kb Flash (2Kb used for Arduino bootloader)
- ▶ 512 bytes EEPROM
- ▶ 14 Digital IO Pins
- ▶ 6 PWM Pins (included in the 14 digital)
- ▶ 8 Analog Input Pins (10 bit)

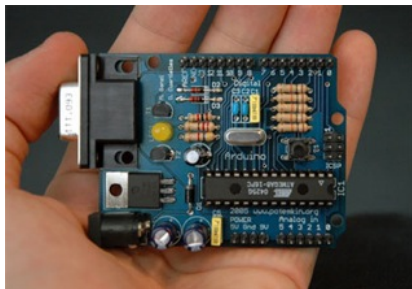
The Arduino vs Do It Yourself AVR

AVR Mega148	\$4
Breadboard	\$5
FTDI Chip/Cable	\$20

Parts \$29	Arduino \$35 assembled
-------------------	-------------------------------

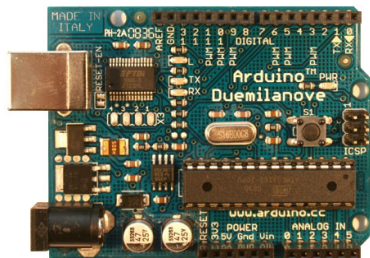
In the end, you can use microcontroller outside the Arduino PCB, so feel free to mix n match.

The Original



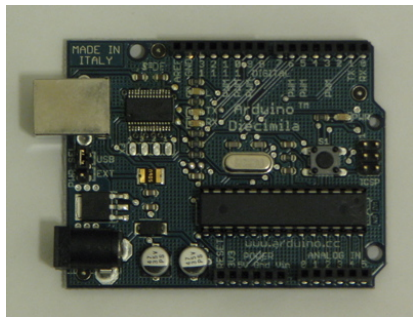
- ▶ First Arduino
- ▶ ATmega8 Microcontroller
- ▶ Serial Connection
- ▶ No LEDs on board
- ▶ Several DIPs to change settings

Duemilanove



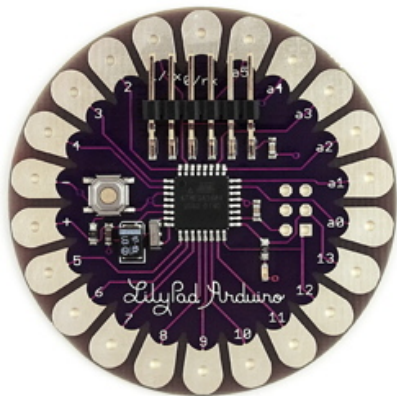
- ▶ Current generation Arduino
- ▶ Automatic DC/USB Power

The Diecimilia



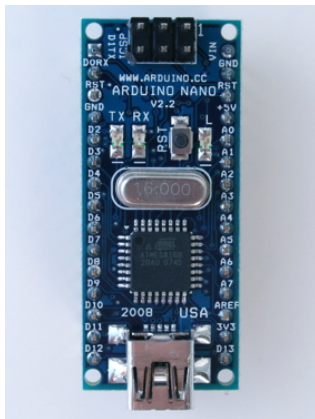
- ▶ AVR Mega148
- ▶ USB or DC Power via DIP Switch

LillyPad



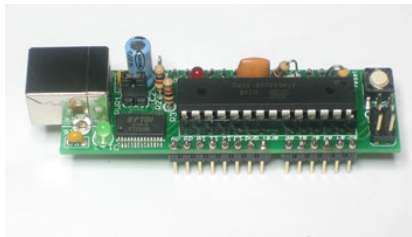
- ▶ 2inch Arduino model
- ▶ Designed to be sewen into clothing
- ▶ Uses FTDI connector (no direct USB)
- ▶ Slightly lower power requirements than other models

Nano



- ▶ Smallest Arduino available
- ▶ USB connector directly on the unit (no FTDI cable needed)

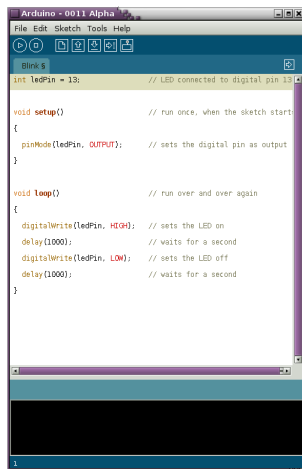
Boarduino



- ▶ Arduino Clone from AdaFruit
- ▶ Available assembled, in parts kit, or PCB-only
- ▶ 100% Arduino Compatible (though not quite the same HW)
- ▶ Clones are legal, as long as they don't use Arduino Trademark

Arduino Software

- ▶ Java based IDE
- ▶ Built-in Project Manager
- ▶ Libraries and pre-done projects (called sketches)
- ▶ gcc-avr w/ lots of libraries and macros under the covers



```
Arduino - 0011 Alpha
File Edit Sketch Tools Help
Blink 5
int ledPin = 13; // LED connected to digital pin 13

void setup() // run once, when the sketch starts
{
  pinMode(ledPin, OUTPUT); // sets the digital pin as output
}

void loop() // run over and over again
{
  digitalWrite(ledPin, HIGH); // sets the LED on
  delay(1000); // waits for a second
  digitalWrite(ledPin, LOW); // sets the LED off
  delay(1000); // waits for a second
}
1
```

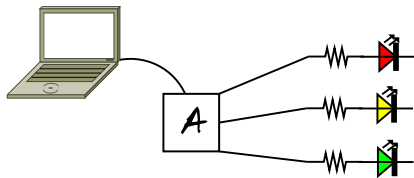
Hello World on the Arduino

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

void setup()       // run once, when the sketch starts
{
  pinMode(ledPin, OUTPUT); // sets the digital pin as output
}

void loop()        // run over and over again
{
  digitalWrite(ledPin, HIGH); // sets the LED on
  delay(1000);                // waits for a second
  digitalWrite(ledPin, LOW);  // sets the LED off
  delay(1000);                // waits for a second
}
```

- ▶ Computer → Arduino → LEDs
- ▶ Adjust LED brightness
- ▶ Indicator lights or a primitive Ambient Orb



LED Change Code (Arduino)

// Simple LED on at various power levels - Serge

```
char serInString[10]; // array that will hold the bytes of the incoming string
int dataRead = 0;

void setup(){
  // Set up pins
  Serial.begin(9600); }

void readSerialString(char *strArray) {
  int i = 0;
  while (Serial.available()) {
    strArray[i] = Serial.read();
    i++; }
  dataRead = i; }

void loop() {
  readSerialString(serInString);
  if (dataRead>0) {
    int ledPin = serInString[0];
    int ledBrightness = serInString[1];
    if ((ledPin>=9) && (ledPin<=11)) {
      char pinChar = '0' + ledPin;
      Serial.println("Turning on LED: " + pinChar);
      analogWrite(ledPin, ledBrightness); } }
  dataRead = 0;
  delay(1000); }
```

LED Change Code (Computer)

```
#!/usr/bin/env python

import serial

SERIAL = serial.Serial('/dev/ttyUSB0', 9600, timeout=1)
RED = 9
GREEN = 10
BLUE = 11

def setLed(led, val):
    SERIAL.write(chr(led))
    SERIAL.write(chr(val))

setLed(RED, 128)
setLed(GREEN, 255)
```

Arduino Shields

Lots of Arduino Add-Ons have been made that fit the standard Arduino form

- ▶ Ethernet
- ▶ Battery
- ▶ GPS
- ▶ WaveShield (lots of audio functions)
- ▶ XBee
- ▶ Motor Control
- ▶ Phidget Sensor
- ▶ Lots more!

Botanicalls



- ▶ Now your plants can tell you to water them in the only way you'll pay attention- on Twitter!
- ▶ Uses Ethernet Shield
- ▶ Available from AdaFruit

Pocket Piano Arduino Shield

A tiny little synthesizer, 25 keys

- ▶ Original page www.critterandguitari.com
- ▶ Makershed page (with video) www.makershed.com

Gamepack

- ▶ “Open Source Game System”
- ▶ 320x240 OLED Touch Screen
- ▶ Lithium Battery Pack
- ▶ Built it yourself! Design your own games
- ▶ Only \$250. Available at liquidware.com

Learning More

- ▶ <http://Arduino.cc>
- ▶ Online Tutorial
- ▶ Another Tutorial
- ▶ *Getting Started with Arduino and Making Things Talk* by O'Reilly
- ▶ *Arduino Programming Notebook*
- ▶ Make Magazine and Instructables
- ▶ Arduino and Parts at AdaFruit and MakerShed
- ▶ Go to Youtube and search for Arduino

Conclusion

- ▶ Electronics doesn't have to be scary
- ▶ Microcontrollers are even less scary
- ▶ Small computers led to lots of cool projects
- ▶ Go forth and hack!

Questions?

License and Redistribution

The text of this presentation is Copyright Serge Wroclawski 2009©

The images in this presentation are distributed with permission from their authors

Redistribution of the text of this presentation is allowed under the terms of the Creative Commons AttributionShareAlike License