



2.017 DESIGN OF ELECTROMECHANICAL ROBOTIC SYSTEMS

Fall 2009 Lab 1

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1. Microcontrollers

- Introduction to microcontrollers
- Arduino microcontroller kit

2. Sensors and Signals

- Analog / Digital sensors
- Data acquisition
- Data processing and visualization

3. GPS and Data Logging

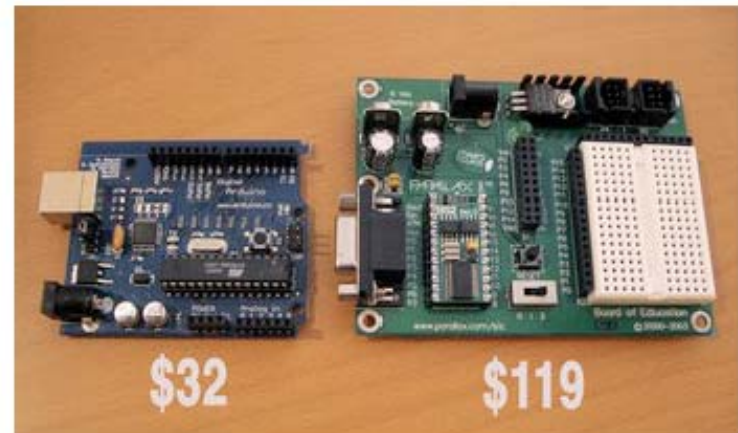
- GPS receiver and shield
- Data logging
- Visualization of data

4. Motor Control

- Motors
- Encoders
- Position control

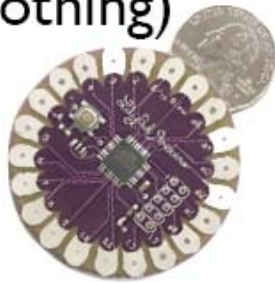
Why Arduino

- Popular
- Open source
- Low cost
- Large user community
- Easy to use development environment



Arduino Hardware

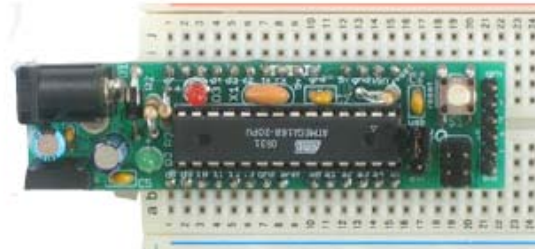
LilyPad
(for clothing)



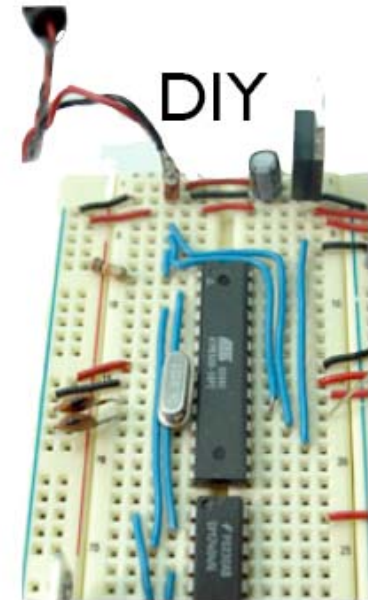
USB



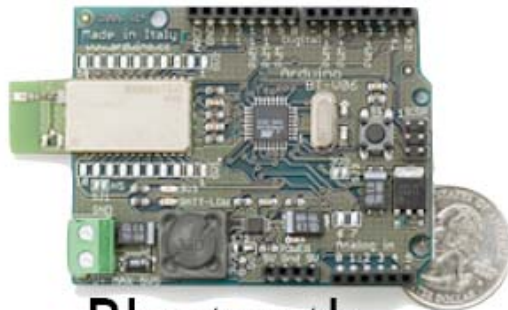
Boarduino Kit



DIY



“Stamp”-sized



Bluetooth

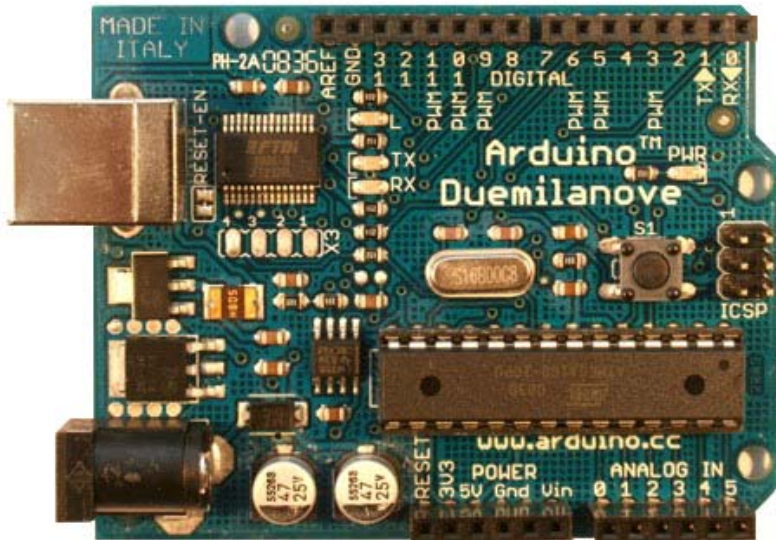
many different variations to suite your needs

<http://todbot.com/>

Arduino Duemilanove Microcontroller



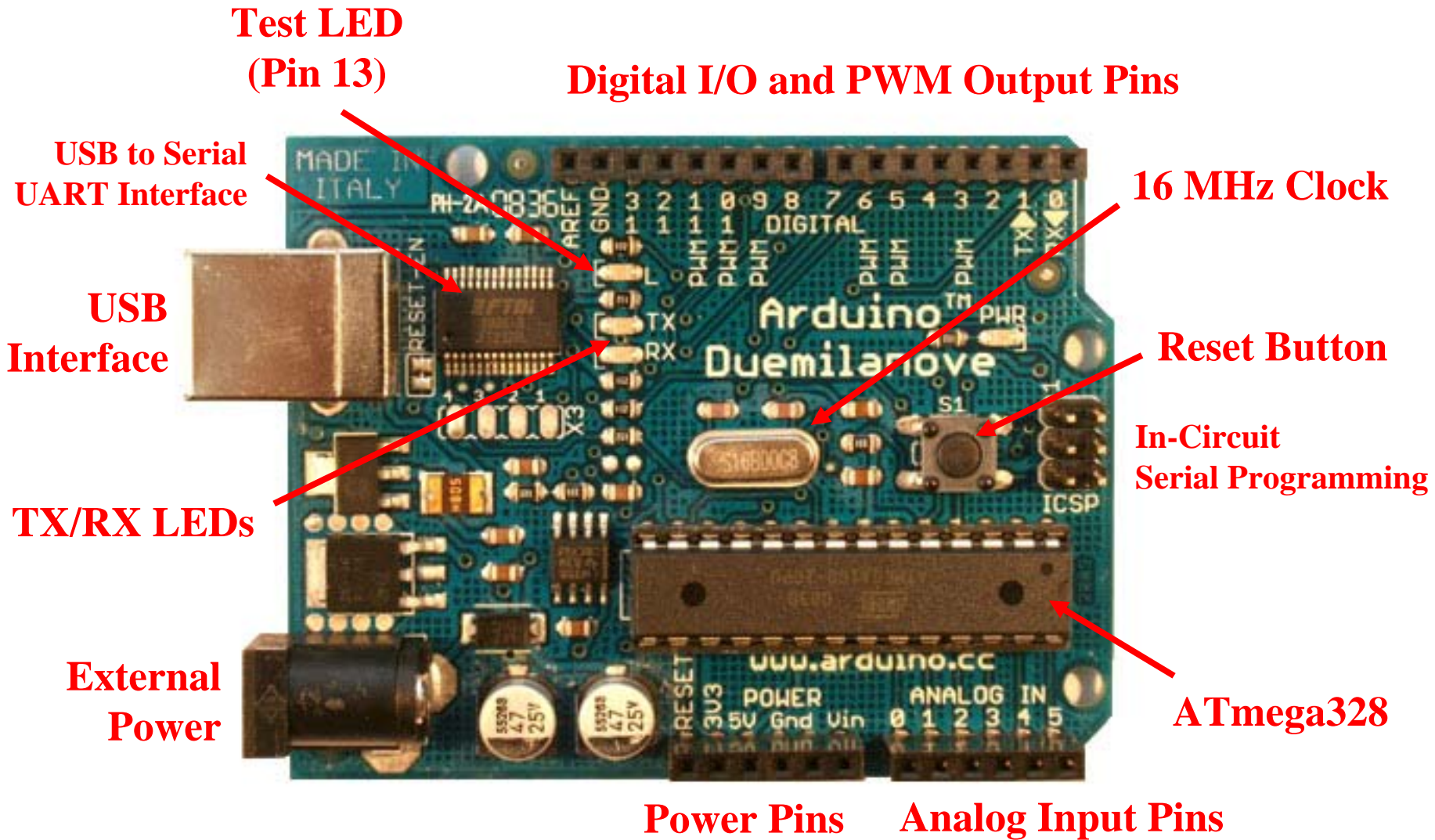
<http://www.arduino.cc/>



Expandable by stacking add-on modules for data storage, wireless, GPS, audio, motor drive,... etc.

Microcontroller	8-bit ATmega328 (by ATMEL)
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328) of which 2 KB used by bootloader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz

Arduino Components



Arduino Programming Environment



- Open source
- Simplified C++ like development environment that is easy to program and to upload the code
- Several examples are included that demonstrate various I/O capabilities
- Built-in libraries that simplify data I/O tasks
- Large user community



Resources



- <http://arduino.cc/>
- <http://ladyada.net/learn/arduino/>
- <http://todbot.com/blog/category/arduino/>
- <http://freeduino.org/>
- <http://adafruit.com/>
- <http://sparkfun.com/>
- Books:
 - “Arduino Programming Notebook”, Brian W. Evans
 - “Physical Computing”, Dan O’Sullivan & Tom Igoe
 - “Making Things Talk”, Tom Igoe
 - “Hacking Roomba”, Tod E. Kurt

Labs 1 & 2: The Arduino Kit Experiments



- {CIRC01} Getting Started - (Blinking LED)
- {CIRC02} 8 LED Fun - (Multiple LEDs)

Lab 1

- {CIRC03} Spin Motor Spin - (Transistor and Motor)
- {CIRC04} A Single Servo - (Servos)
- {CIRC05} 8 More LEDs - (74HC595 Shift Register)
- {CIRC06} Music - (Piezo Elements)

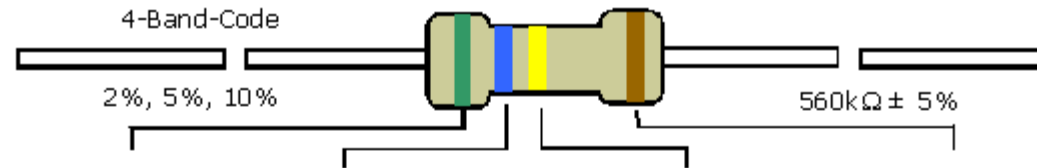
- {CIRC07} Button Pressing - (Pushbuttons)
- {CIRC08} Twisting - (Potentiometers)

Lab 1

- {CIRC09} Light - (Photo Resistors)
- {CIRC10} Temperature - (TMP36 Temperature Sensor)
- {CIRC11} Larger Loads - (Relays)

Lab 2

Resistor Color Code Chart



COLOR	1st BAND	2nd BAND	3rd BAND	MULTIPLIER	TOLERANCE
Black	0	0	0	1Ω	
Brown	1	1	1	10Ω	± 1% (F)
Red	2	2	2	100Ω	± 2% (G)
Orange	3	3	3	1KΩ	
Yellow	4	4	4	10KΩ	
Green	5	5	5	100KΩ	±0.5% (D)
Blue	6	6	6	1MΩ	±0.25% (C)
Violet	7	7	7	10MΩ	±0.10% (B)
Grey	8	8	8		±0.05%
White	9	9	9		
Gold				0.1	± 5% (J)
Silver				0.01	± 10% (K)



Electronix Express / RSR
<http://www.elexp.com>

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