



# Designing Interactive Systems II

*Computer Science Graduate Programme SS 2010*

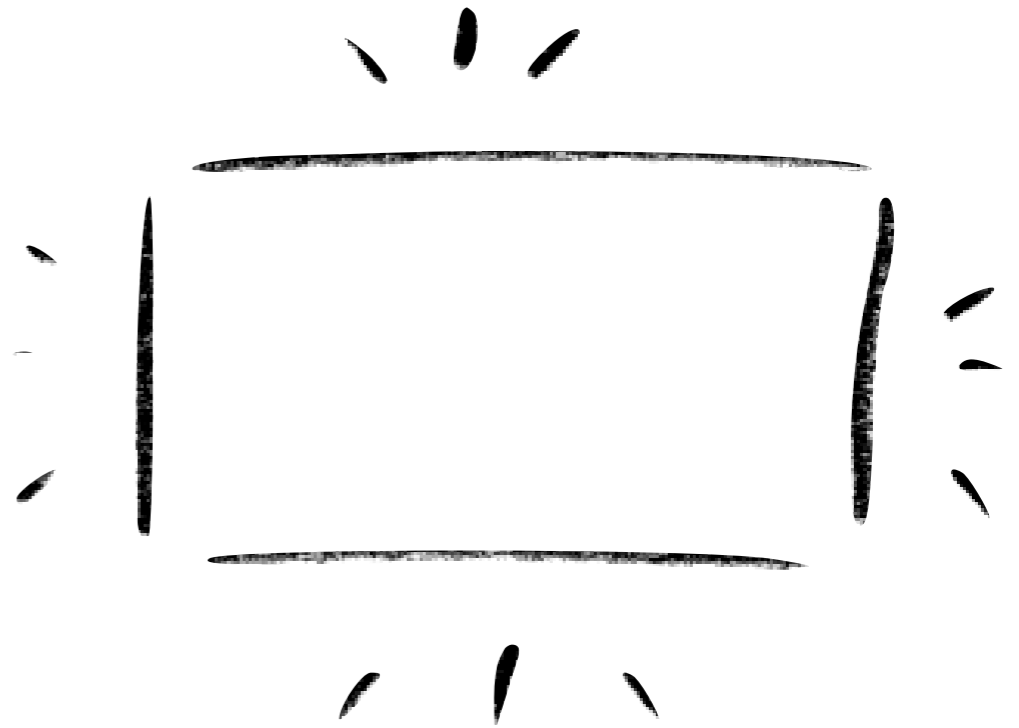
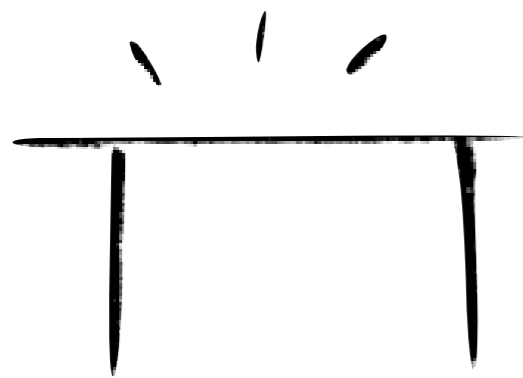
Prof. Dr. Jan Borchers  
RWTH Aachen University

<http://hci.rwth-aachen.de>



# Physical Computing









VOLTREG

MALECONN

CONNECT

JUMPERS

MING

WASHBATT

SWITCHES.

PUSHBUT

ALLICLIP

DIPSWITCH

9VHOLD

9V

9VHOLD

WASHHOLD

BATT

PRO WICK



# Toolkits



**4 Visual Ubicomp UI Prototyping Software**  
*iStuff Mobile, Exemplar,...*

**3 Ubiquitous Technology Prototyping  
Middleware**  
*iStuff, d.tools, (Phidgets),...*

**2 Programmable  $\mu$ Controller Boards**  
*Arduino, Wiring, MAKE Controller,  
iCubeX, Basic Stamp,...*

**1 Dumb Interfaces to Sensors & Actuators**  
*MidiTron, MidiTron Wireless,...*





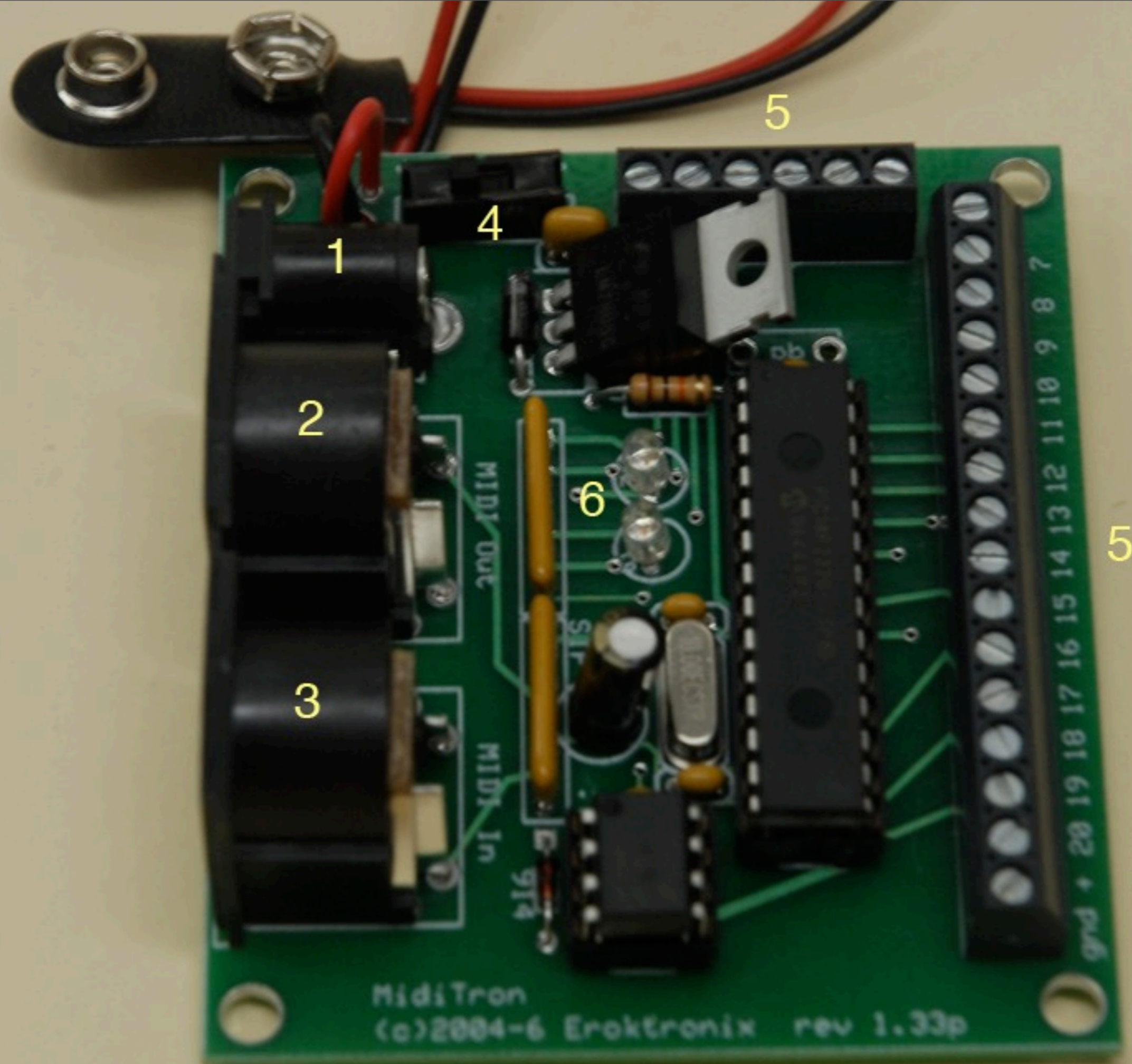
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1

2

3

4

6

5

5

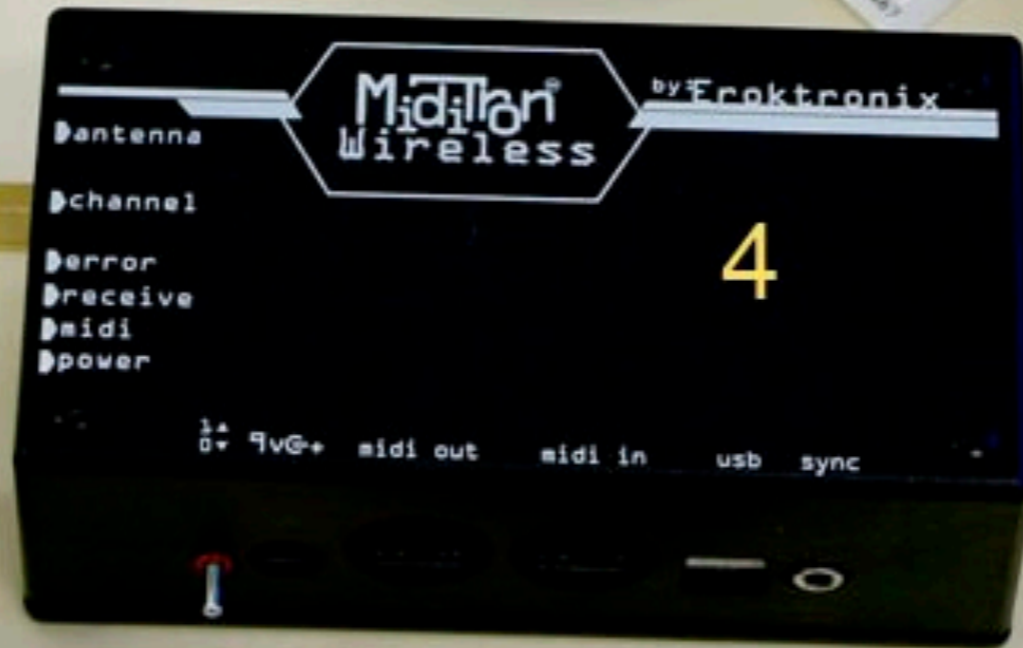
MidiTron  
(c)2004-6 Eroktronix rev 1.33p

5V 100mA  
1 2 3 4 5  
6 7 8 9 10 11 12 13 14 15 16 17 18 19 20





3



5



7



**4 Visual Ubicomp UI Prototyping Software**  
*iStuff Mobile, Exemplar,...*













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	MIDI	Serial	USB	BT	Stand-alone
Win/Mac/Linux	iCubeX \$\$\$ 		 Phidgets \$\$  MAKE Con- troller \$\$ 	Arduino \$  	 
Win/Mac					
Win			Basic Stamp  \$\$		 

**4 Visual Ubicomp UI Prototyping Software**  
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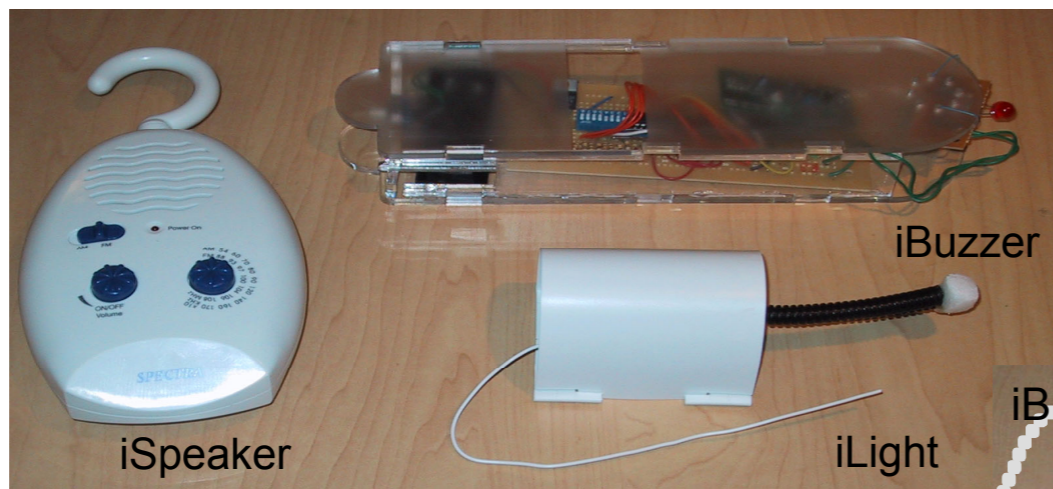
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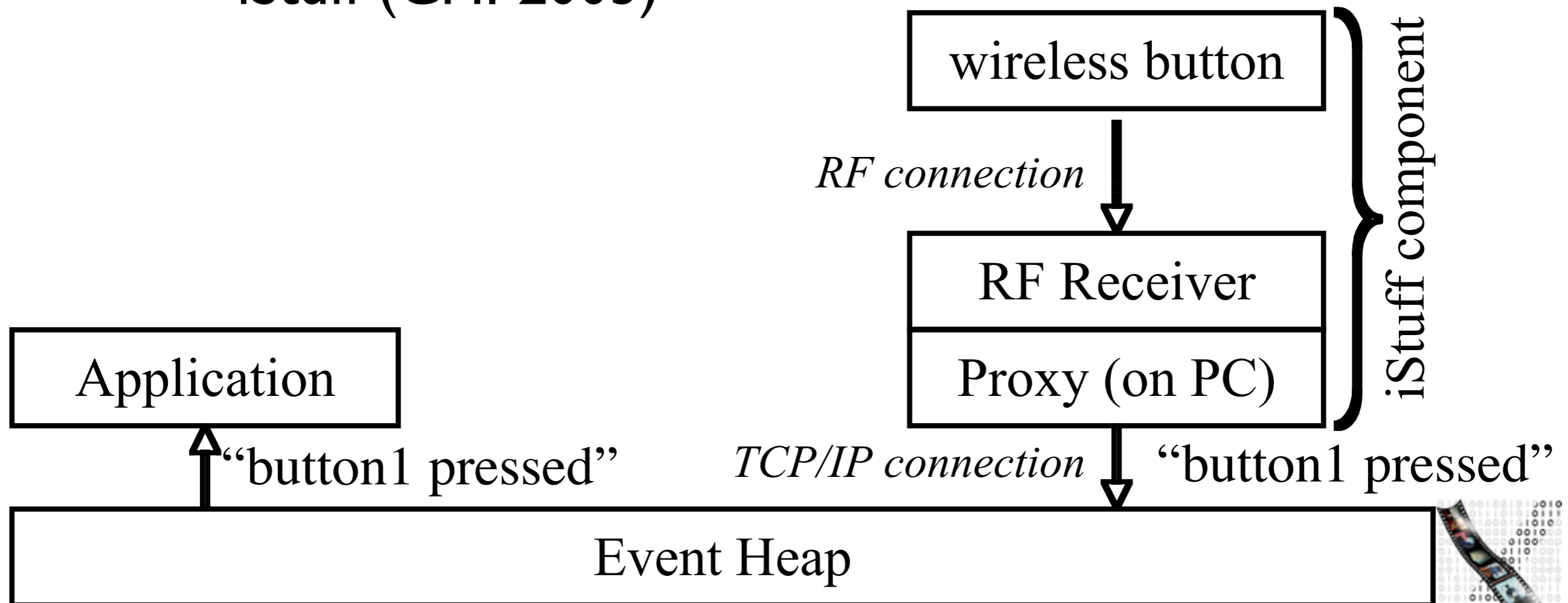
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## iStuff (CHI 2003)



## 4 Visual Ubicomp UI Prototyping Software

*iStuff Mobile, Exemplar,...*

## 3 Ubiquitous Technology Prototyping Middleware

*iStuff, d.tools, (Phidgets),...*

## 2 Programmable $\mu$ Controller Boards

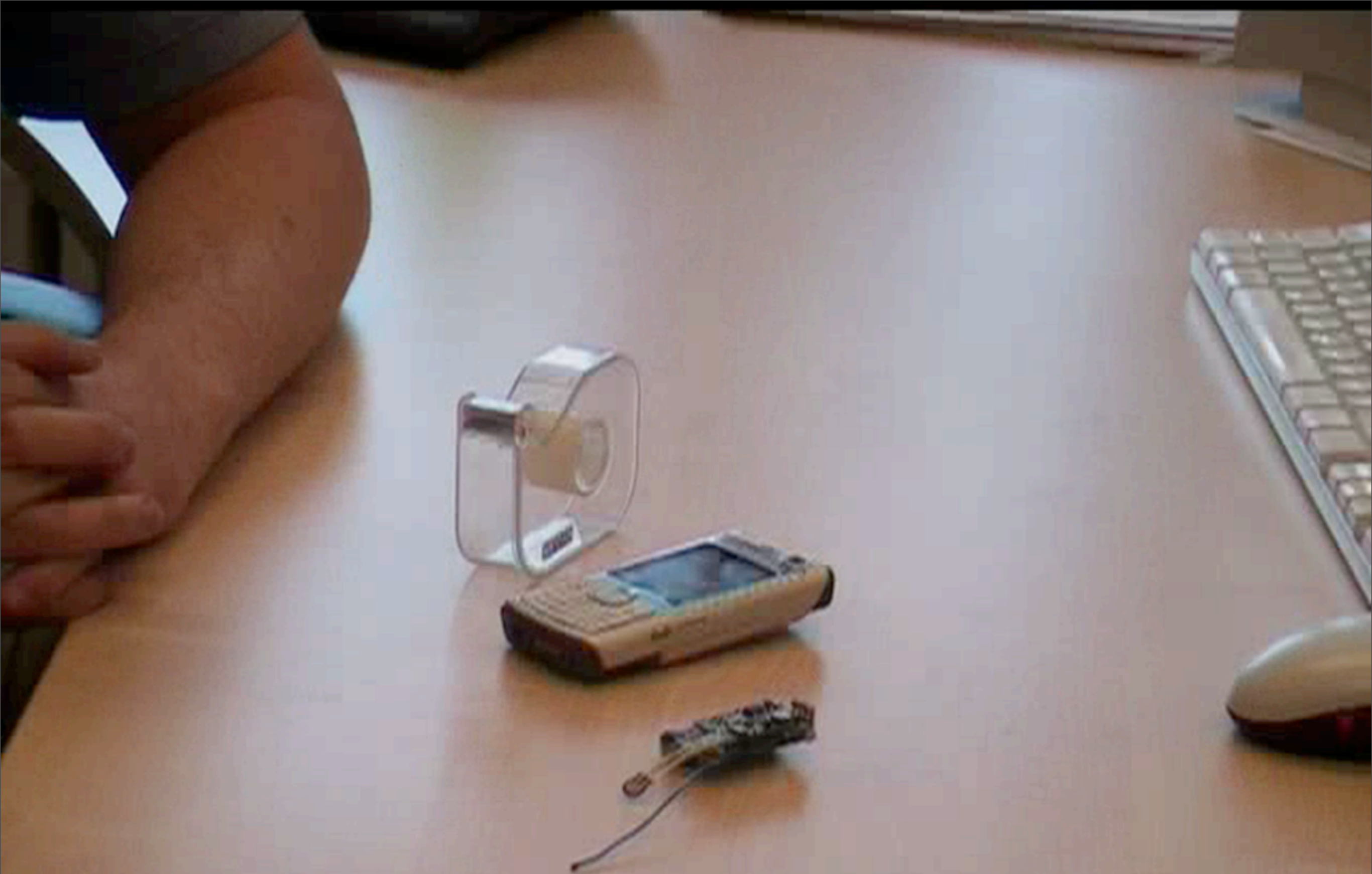
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## 1 Dumb Interfaces to Sensors & Actuators

*MidiTron, MidiTron Wireless,...*







<http://hci.rwth-aachen.de/videos/istuff/iStuffMobile.mov>

# Arduino Crash Course





14 digital I/O (40mA)  
6 PWM 'analog' out

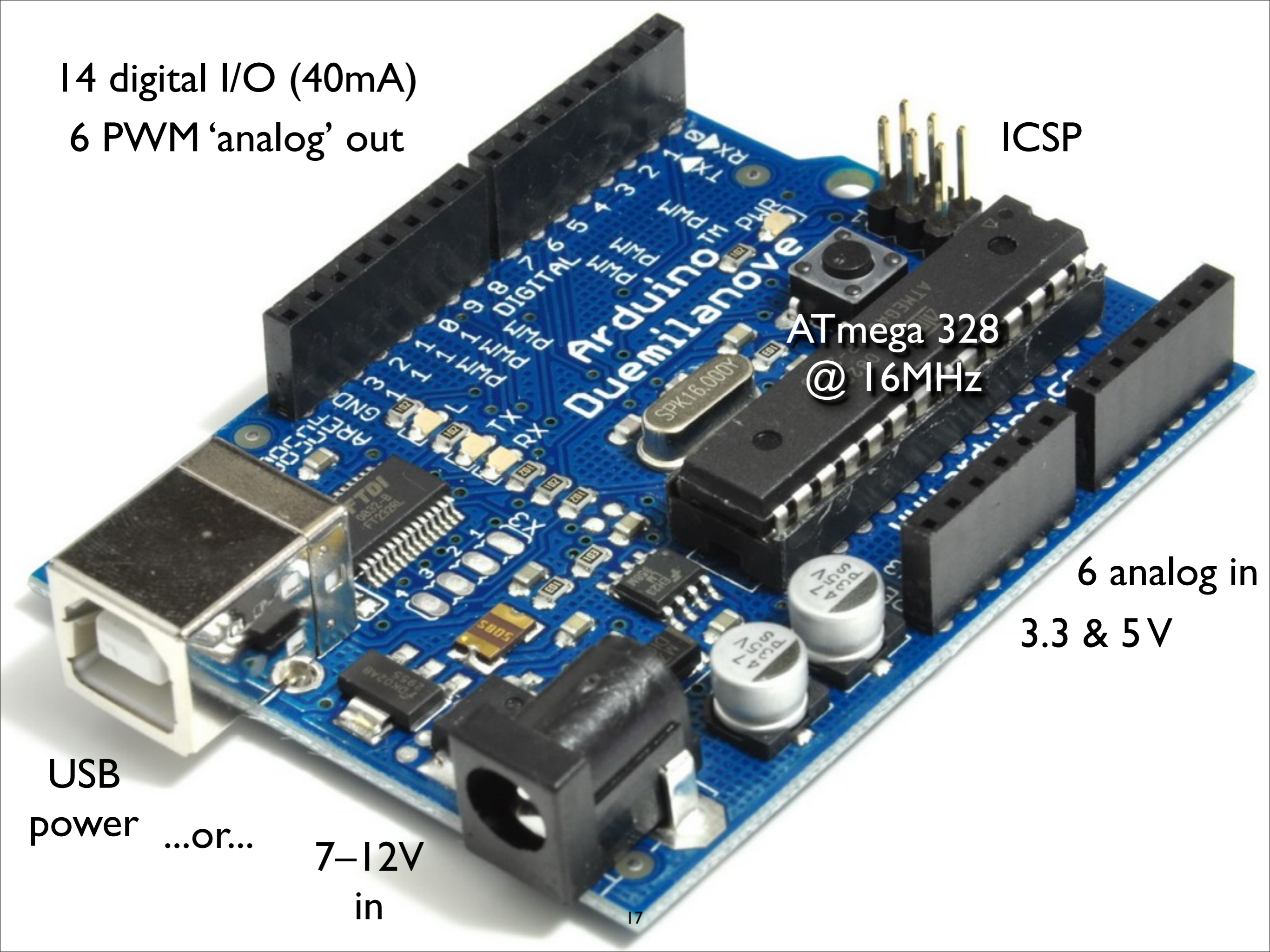
ICSP

ATmega 328  
@ 16MHz

6 analog in  
3.3 & 5V

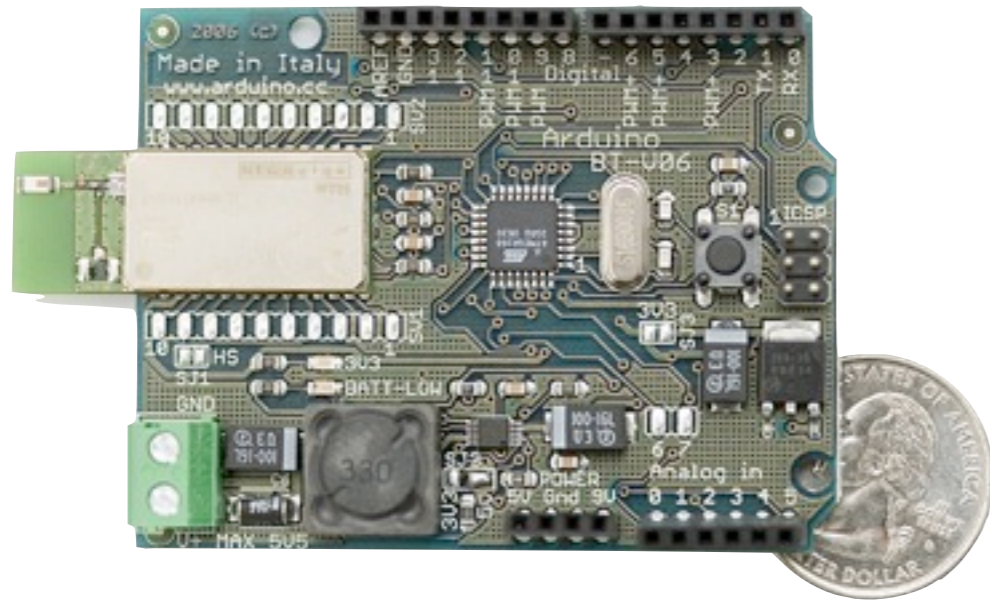
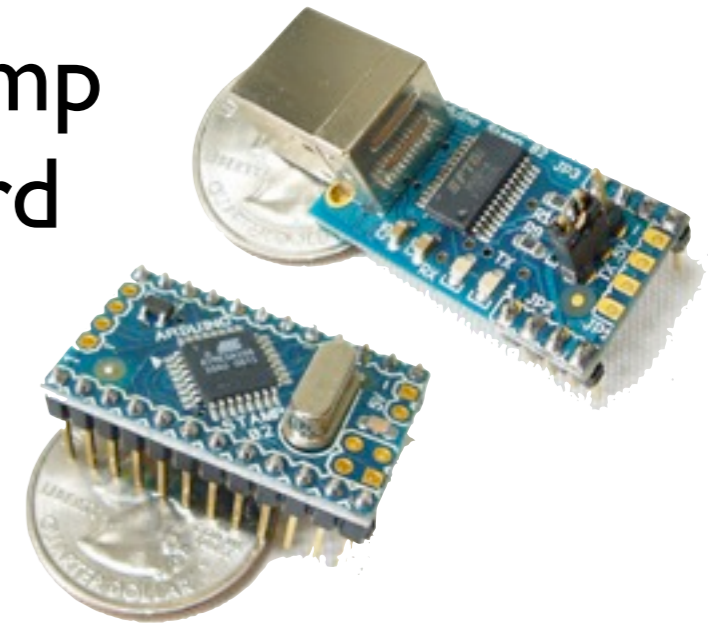
USB  
power ...or...

7-12V  
in





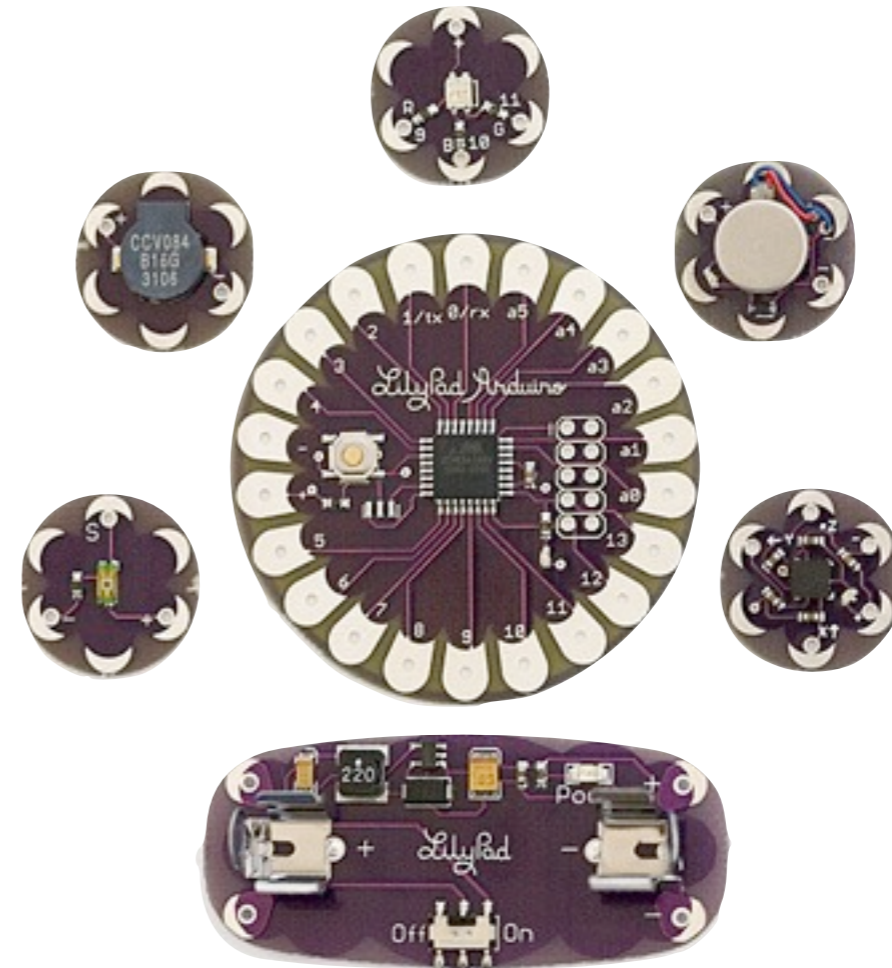
# Arduino Stamp & USB board



# Arduino Bluetooth



# Arduino ZigBee Shield



# Arduino Lilypad



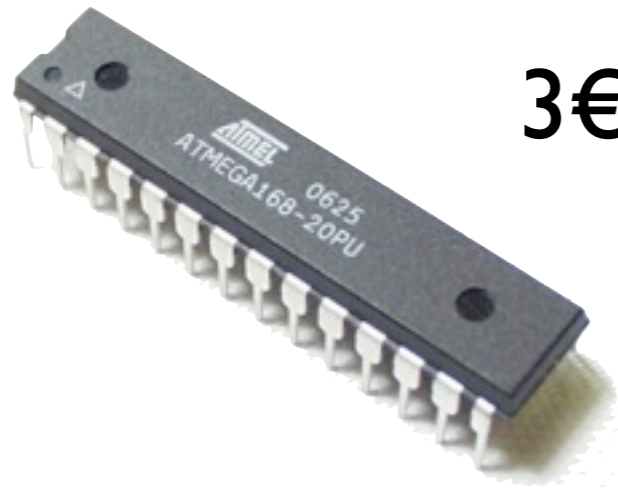




# Arduino

```
int ledPin = 13;
void setup() {
  pinMode(ledPin, OUTPUT);
}
void loop() {
  digitalWrite(ledPin, HIGH);
  delay(1000);
  digitalWrite(ledPin, LOW);
  delay(1000);
}
```



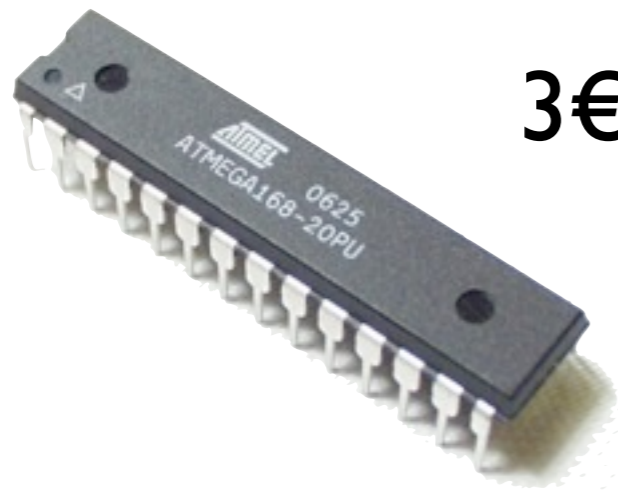


3€

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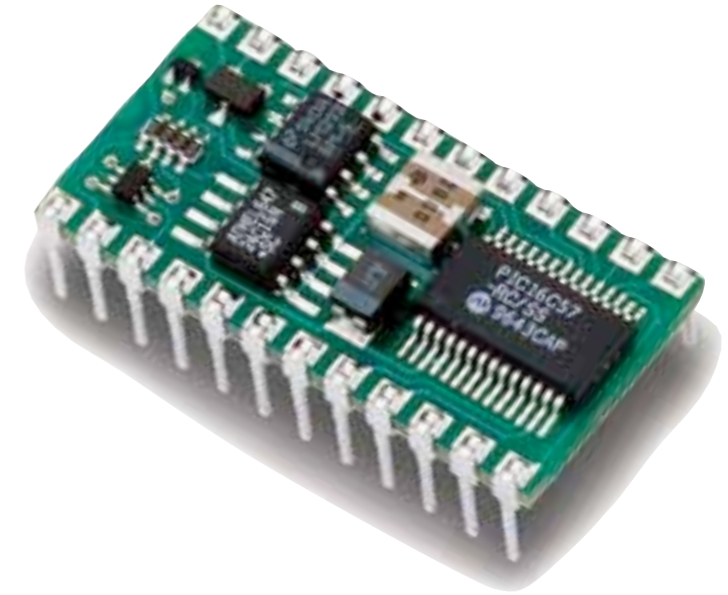




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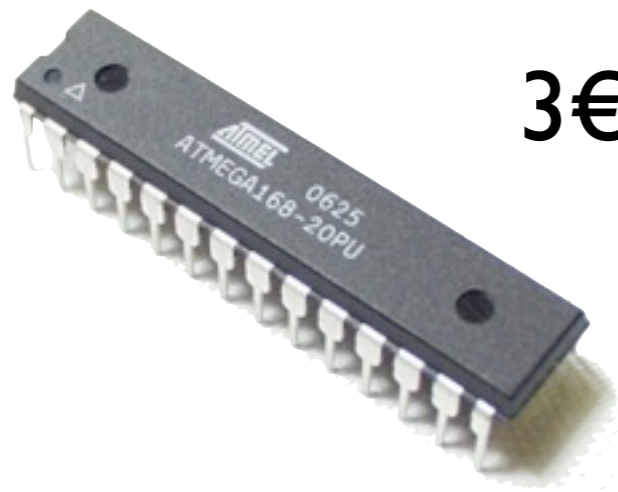


## Basic Stamp

```
'{$STAMP BS2}
'{$PBASIC 2.5}
OUTPUT 14
DO
  HIGH 14
  PAUSE 1000
  LOW 14
  PAUSE 1000
LOOP
```



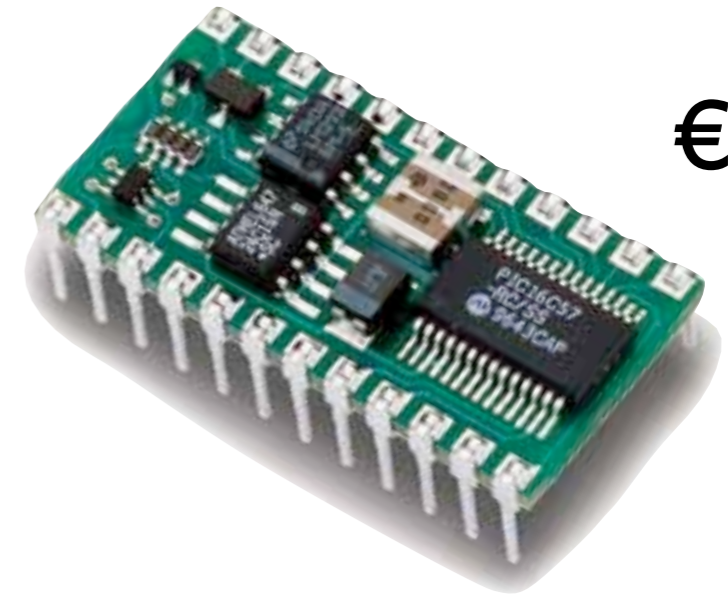




3€

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€50

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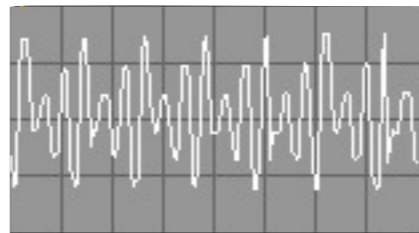
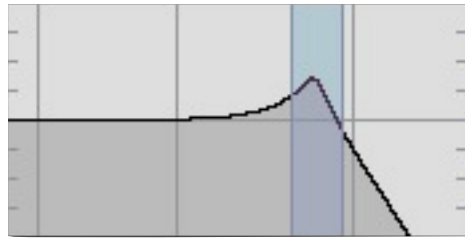
# Arduino Language

- C with some C++ constructs
- Similar to Processing (for visual programming)
- Links against AVR-libc (open-source gcc library for Atmel  $\mu$ Controllers)
- All programs have `setup()` and `loop()`
- Of note: digital & analog I/O, pulse and shift output, timers, interrupts, serial communication, port manipulation, flash memory access



148. phasor~ 50. 0.75  
cycle~ 440. \*~ 0.0  
\*~ 0.0

# Max/MSP



biquad~

\*~ 0.5 0.



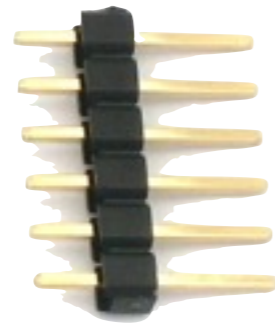
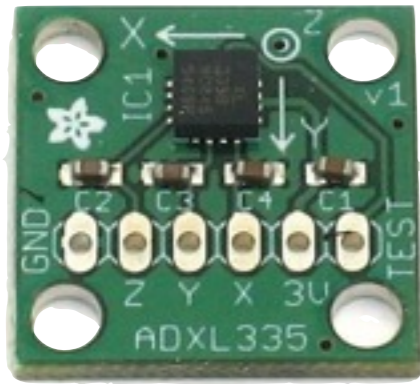
# Flash



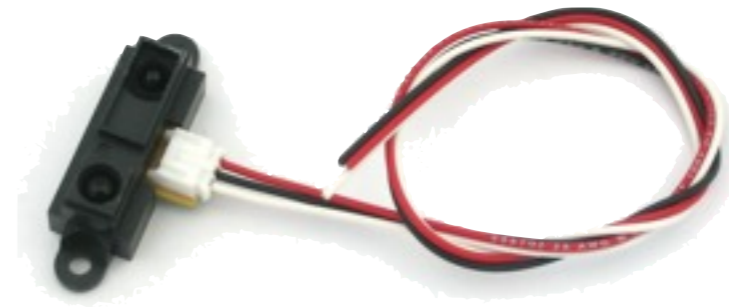
# Processing







3-axis accelerometer (20€)



IR distance sensor (13€)



Hall effect sensor (2€)



Sonar sensor (30€)



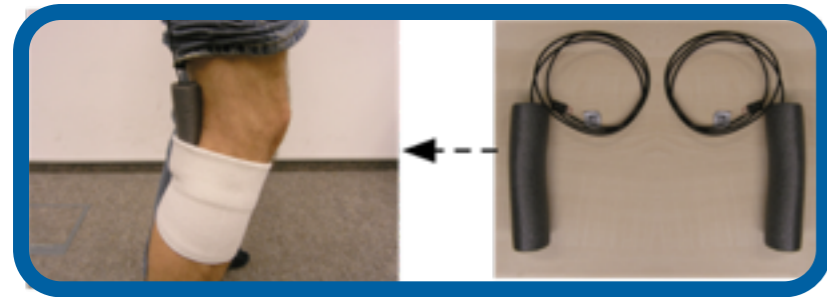
Tilt ball switch (2€)



Photocell (1€)

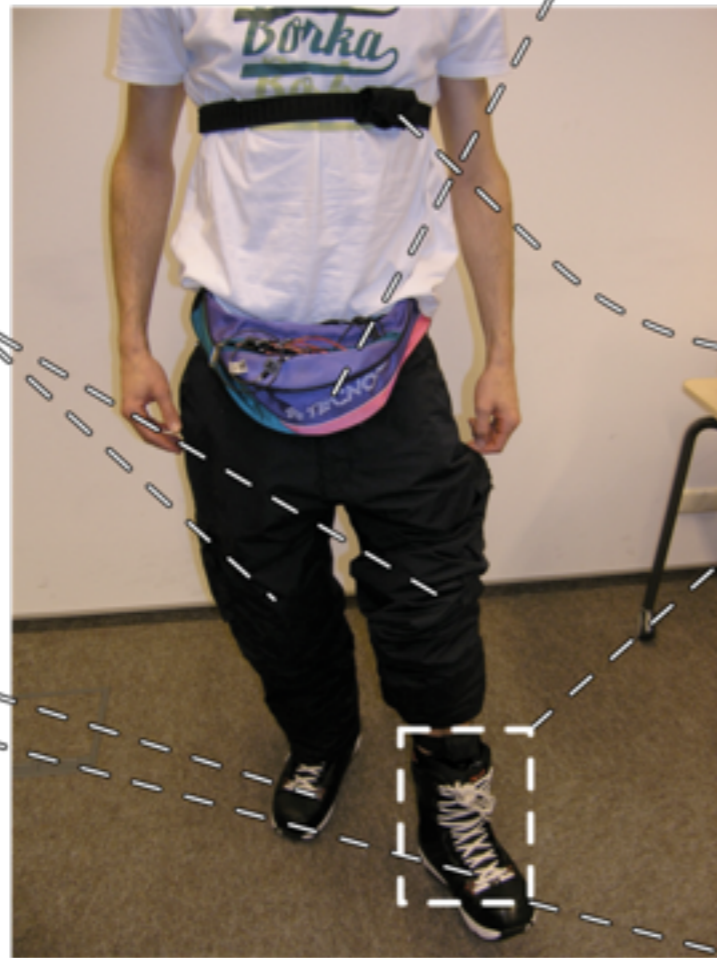


# Example from our group: Wearable Snowboard Assistant

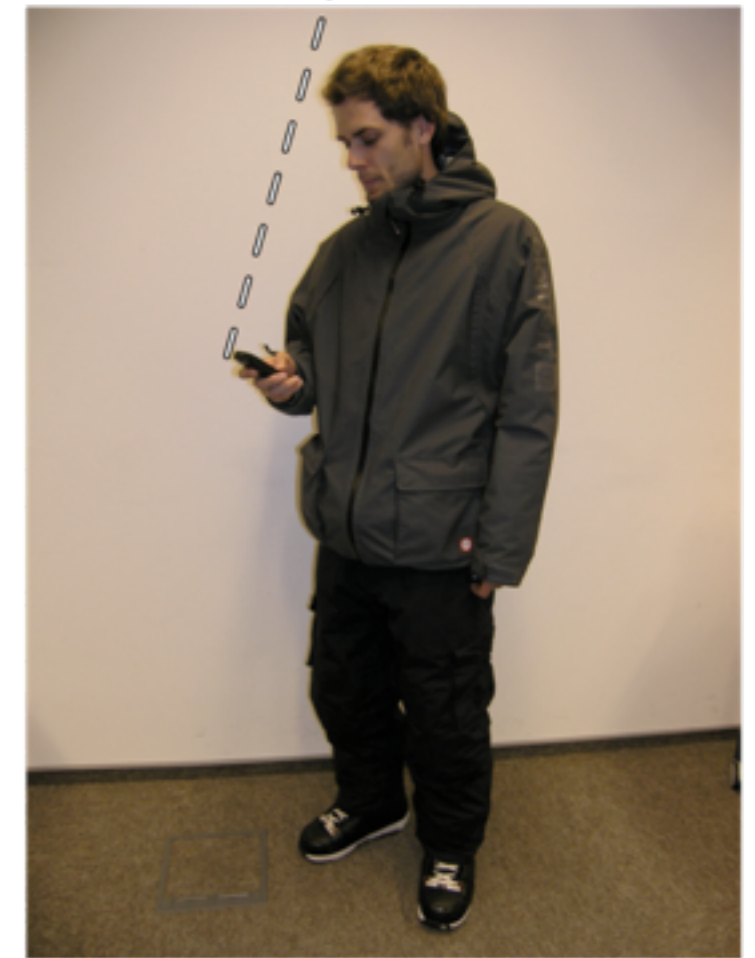


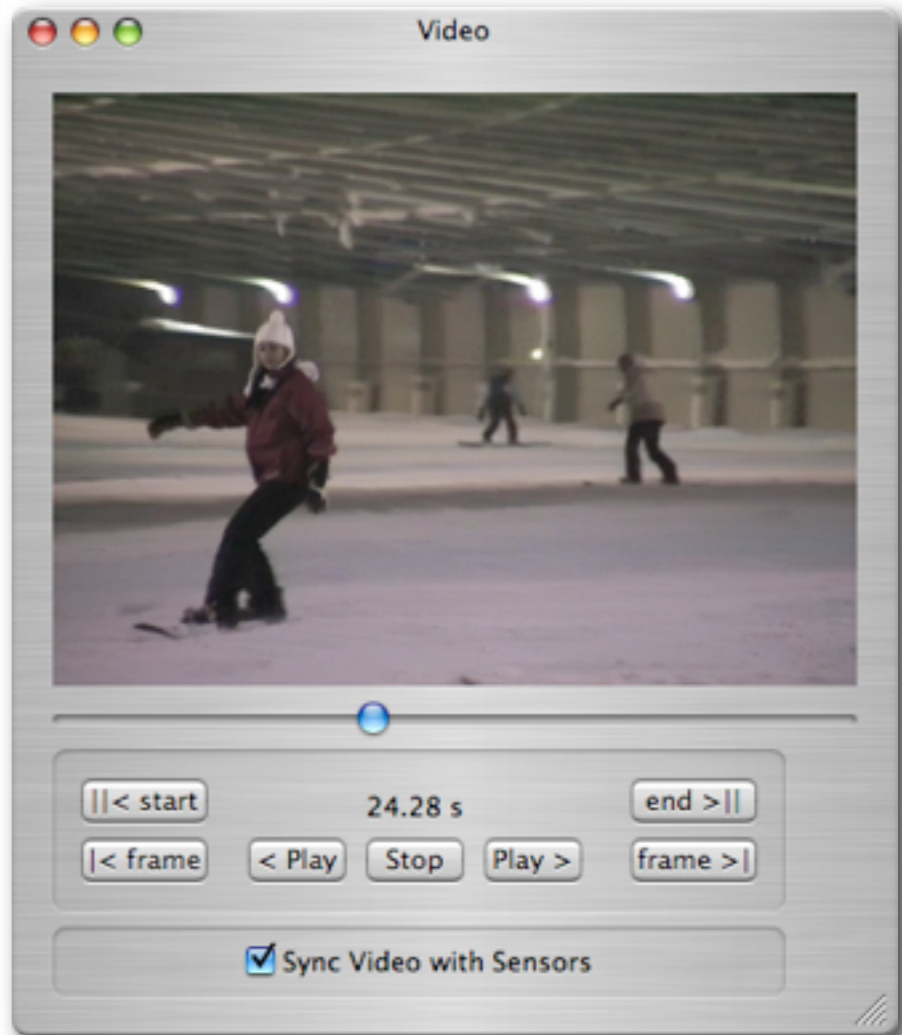
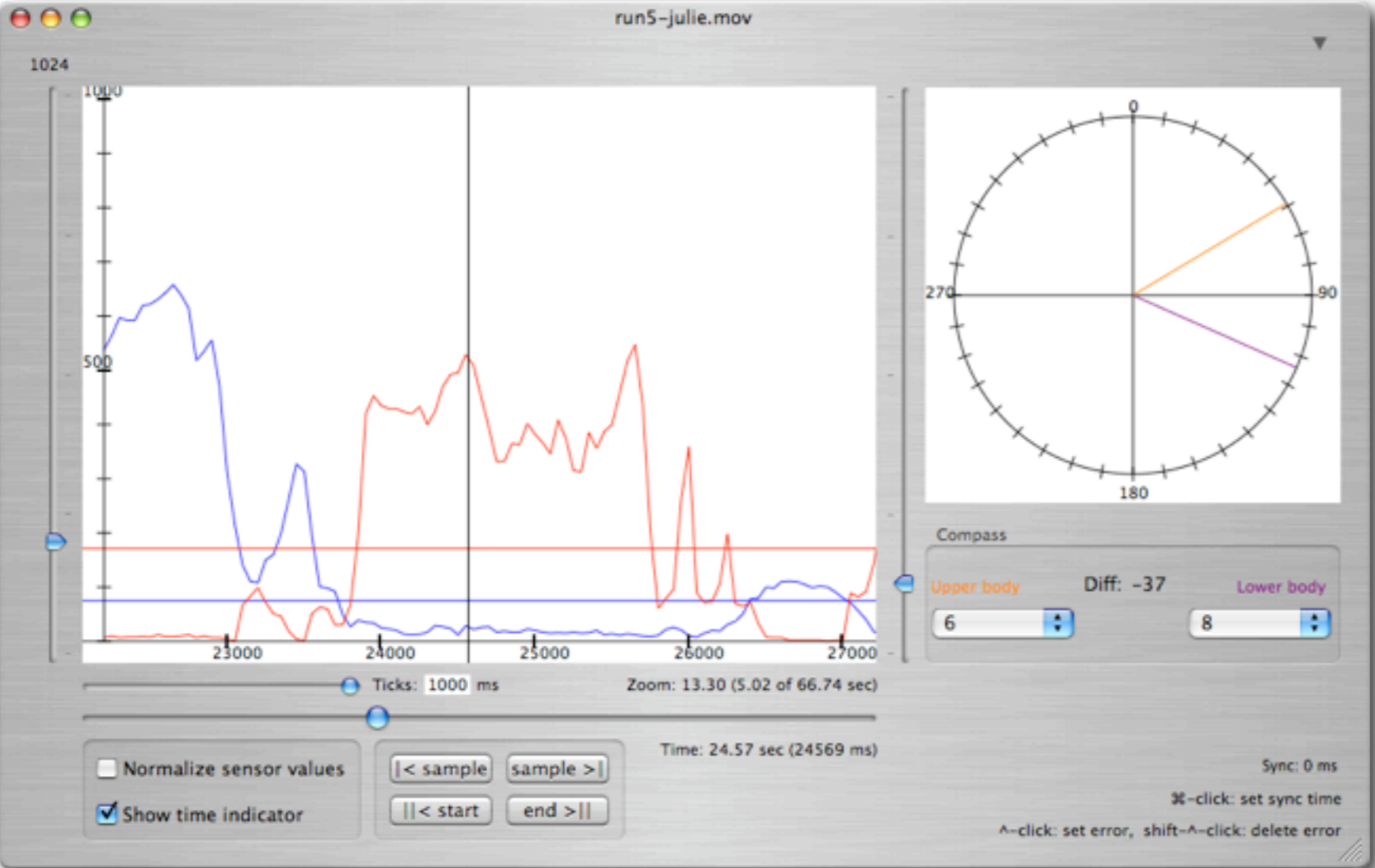
Sensor interface  
(Arduino BT)

Mobile phone



Digital  
compass









Sonic Body

# Arduino and You

1. Buy 30€ Arduino Duemilanove board, download and install free development IDE & USB driver (all via [www.arduino.cc](http://www.arduino.cc))
2. Plug in board using a USB cable, launch IDE, select menu “Tools:Serial Port:/dev/tty/usbserial..”, select “File:Sketchbook:Examples:Digital:Blink”, then select “File:Upload”
3. There is no step 3



# If it doesn't work

- Select “Arduino Duemilanove” in the “Tools:Board” menu
- Windows users, use “run.bat” to launch IDE instead of executable
- Get latest USB driver from <http://www.ftdichip.com/Drivers/VCP.htm>





# Summary

- The case for physical prototyping toolkits
- Dumb interfaces,  $\mu$ Controllers, middleware, IDEs
- Arduino: modern, open-source, cross-platform, cheap



# More Info

- <http://hci.rwth-aachen.de/toolkits>
- <http://arduino.cc>
- <http://www.ladyada.net/learn/arduino/>

