Arduino Class Notes

Natasha

DAY 1

Install CapSense Library (on Macintosh)

Go to Applications>Arduino
Right-click on Arduino “Show Package Contents”
Contents>Resources>Java>Libraries
Drag and Drop the “CapacitiveSense003” Folder

*DO NOT CHANGE THE NAME OF THE FOLDERS

New musical instrument building (eLutherie) belongs in the plastic arts
Modulations and changes/transformations of things in space

New Media vs New Implementation
Same knowledge of art/music/making framed using new tools.

PHILOSOPHIES IN MAKING & THE HISTORY OF ELECTRONICS

Playing at the beach:

- Water = Software (easily in flux)
- Dry Sand = Hardware (things that don't change)
- Wet Sand: the spot = use both together to build things

Everything that is solid was once and will be liquid or gas.
We are rewinding to get back to fluid state to shape things.
If you can maintain the fluidity, you've made something interactive.
People moving is the soft element, changing their perspective.
Challenge is to build it hard enough to keep it from breaking, soft enough for flexibility to change parameters and interact with.

Chemistry 101 in 30 seconds
Atoms have electrons.
The swarm of electrons is the glue that makes things solid that holds them together.
When you heat them up you get liquid.
Heat up more it becomes gases. Energize furthur and you have Plasma
In some solid materials, this 'glue' is so liquid we can push electrons from one side to another side with relatively low friction.

Engineering Media

- Mechanics (reach this with electronics through solenoid, motors)
- Optics
- Hydraulics
  Pneumatics (French were really good at this from late 1800's)
- Electromagnetics (light, waves)
- Electronics
- Fabrics

All of these:

- Move information from here to there
- Transport energy (sometimes a lot, e.g. Hydraulics)
- Electronics is so important because devices exist to transform from energy and information in and out of the other forms, e.g., electric motor, photocell

SAFETY
*If you're going to work with water and electronics, work with an expert.
*Software is unreliable. Other people's software is unpredictably unreliable. Don't build things with Arduinos where anyone's life is at stake. If in doubt ask an expert.

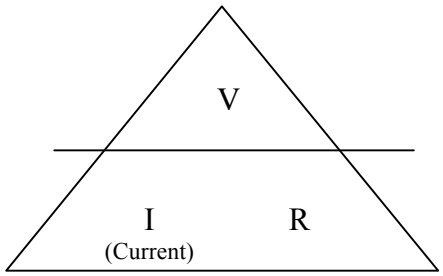
OHMS LAW

Pressure = Voltage = EMF Electromotive Force
How much current flowing through = Current = Amperage

*Straw blowing example
How hard I have to blow = EMF
How much is air flowing through (as felt on my skin) is current
How much I squeeze is Resistance

VERY = Voltage in Volts
IMPORTANT = Current in Amps
RESULT = Resistance in Ohms

Ohms Law
Voltage (V) = Current (I)x Resistance (R)



Cross out the variable you want to see the formula for the other two quantities.

Common voltages

0.2	Germanium and Schottkey Diodes
0.4	Welding
0.6	Silicon Diodes
1.2V	NiMH
1.5V	AA, AAA Alkaline and regular
1.8V	Red LEDs
2V	Green LED
3V	Blue LED
3.3V	Lithium Cells Most Electronics from 1990's on
5V	Most Electronics from 1970 on Arduinos like these
6V	Lantern Battery
9V	9v battery compact battery
12V	Relays, Motors
24V	Motors, Solonoids Above this is where there is danger If your body is wet, will hurt you
48V	Start of Dangerous voltage Telephones
110V	Mains
220-240V	Mains in Europe

CURRENT

< 1 mA	Goal of electronics today is to use this
.02A or 20mA	LED
500mA	USB official maximum (25 LEDS maximum on a usb)
1-10 amp	Car lamps
50-500 mA	Small Motors
5-10 Amp	Big motors (washing machines)
50 Amp	Car motor

RESISTANCE

4 Ohm 8 Ohm 100 Ohm	Speaker Impedance
100 200-500 Ohms	LED Series Resistor
10K	Common external pullup
20I	Internal Pullup
1M	E-field sensing

Stored energy is places like batteries or capacitors, inductors and moving coils or magnets.

Resistors: _____
Capacitors: flash memory. Store. Switch. Move.
Inductors: Turn electric current into magnetic field and back and again. Couldn't miniaturize these when electronics were shrunk to chip livel.

In silicon you can only do:

- MOVE electricity from one place to another
- SWITCH it on and off very
- STORE it very briefly

Each bit of information is stored on about 100 trapped electrons in flash memory.

Sparkfun: Takes newest chips with many small pins and put in a form that you can plug into your breadboards and your Arduino.

CapSense Library

The bigger the resistor, the more distance. The smaller resistor the more accuracy.

- 10 megohms for 2-3 ft
- 1 megohm 6 inches

Fabric. Copper plated nylon with conductive sticky glue.

Input<>Output: Switching them around

Enabling Built in Resistor in the Arduino

```
pinMode(14,INPUT);
digitalWrite(14,HIGH);
```

Potential Dividers

DAY TWO

Ground, Gnd, G, - = Black
Power,VCC, Vdd, Vss, + = Red

LED

Pulse-Width Modulation
This is how to control motor speed and the brightness of lights.

Multiplexing _____
Charlieplexing _____

*Remember 100-200 ohms
If I'm lazy about calculating ohms for resistors, so use 100 ohm resistor. If LED is too bright use 200 ohms.
Using the multimeter to meaure the small speaker we learn that it already has 30 ohms resistance, so take that much off of the resistor number in the circuit.

Serial Protocols

- RS232
- RS45
- RS485
- MIDI
- SPI

EVENTS

Maker Faire: anyone who makes anything out of anything is going to be there
Next weekend May 22-23 in San Mateo

RESOURCES

Book Recommendations for Beginner's Electronics:

1. *Getting Started in Electronics* by Forrest M Mims III (RadioShack)
   - Author Site: http://www.forrestmims.com/
   - Amazon: http://www.amazon.com/dp/0945053282

2. *Getting Started with Arduino* by Massimo Banzi (Make:Makemagazine.com)
   - Publisher Site: http://oreilly.com/catalog/9780596155520
   - Amazon: http://www.amazon.com/Getting-Started-Arduino-Make-Projects/dp/0596155514
   - Google Books: http://books.google.com/books?id=f3xYRaq_4ZYC&lpg=PP1&dq=Getting%20Started%20with%20Arduino%20by%20Massimo%20Banzi&pg=PP3#v=onepage&q&f=false

3. *Make: Electronics* by Charles Platt (O'Reilly & Make:Makemagazine.com)
   - Publisher Site: http://oreilly.com/catalog/9780596153755
   - Amazon: http://www.amazon.com/MAKE-Electronics-Learning-Through-Discovery/dp/0596153740
   - Google Books: http://books.google.com/books?id=PQzYdC3BtQkC&lpg=PP1&ots=8jXKigvg0D&dq=Make%3A%20Electronics%20by%20Charles%20Platt&pg=PR8#v=onepage&q&f=false

Music/art/interactive research centers and departments

CNMAT
Center for New Music and Audio Technology at UCBerkeley
http://cnmat.berkeley.edu/

CCRMA
Center for Computer Research in Music and Acoustics at Stanford
https://ccrma.stanford.edu/

ITP
Interactive Telecommunications at NYU
http://itp.nyu.edu/itp/

IRCAM
L'Institut de Recherche et Coordination Acoustique/Musique at Centre Pompidou, Paris
http://www.ircam.fr/?L=1

Surplus suppliers

All Electronics
www.AllElectronics.com

Electronic Goldmine
www.goldmine-elec.com

BG Micro
www.bgmicro.com
-Yamaha Keyboard Survival Kit $8

Adafruit Industries
www.adafruit.com
-Motor Party add on Kit $42

MakerShed
www.makershed.com

Less EMF
http://www.lessemf.com/f

Seeed Studio
http://www.seeedstudio.com/

Evil Mad Science
www.EvilMadScience.com

NKC Electronics
www.nkcelectronics.com

FutureLEC
www.futurelec.com

Olimex
www.olimex.com
sells the MOD-RFID125 USB RFID reader

Lenmar
www.Lenmar.com
sells the PPUMINI battery pack and charger