Kinetic Art and Embedded Systems

Drawing on Data

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School of Computing

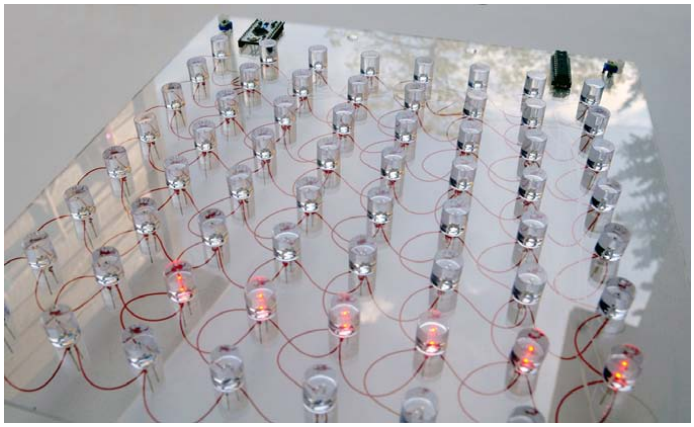
Paul Stout
Dept. of Art & Art History

Logistics

- Class meets from 3:40-6:40pm on Tue and Thu
- Main classroom: Sculpture 178
- Canvas page is the main course web site
- We may not require attendance all the way to 6:40 most days
  - But, you should either plan on staying and using that as work time, or making sure that you plan for extra time out of class if you need to leave

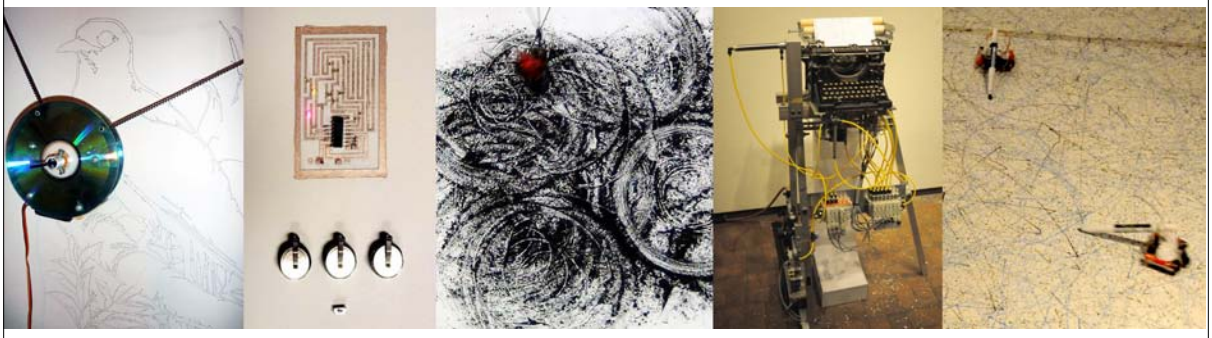
Agenda

We argue that arts/technology collaboration is a powerful framework for enhancing ideas in both arenas



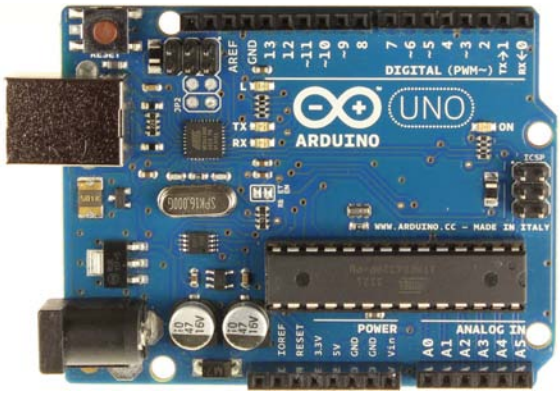
Context

This class explores arts/tech collaboration
in the context of ***kinetic art***
and its connection to ***embedded systems***



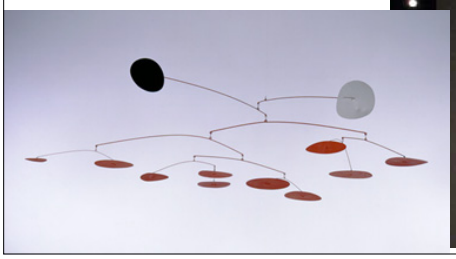
Embedded Systems

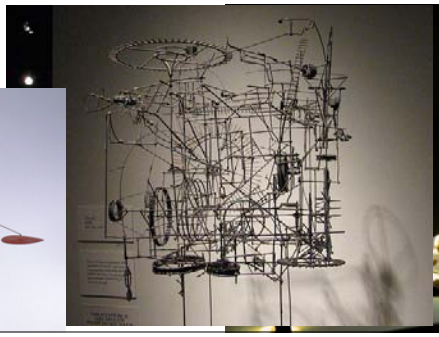
- Computer systems that are embedded into a complete device
  - Often small or special purpose computers or microprocessors
  - Designed to perform one or a few dedicated functions
  - Often reactive to environmental sensors
  - Often designed to directly control output devices



Kinetic Art

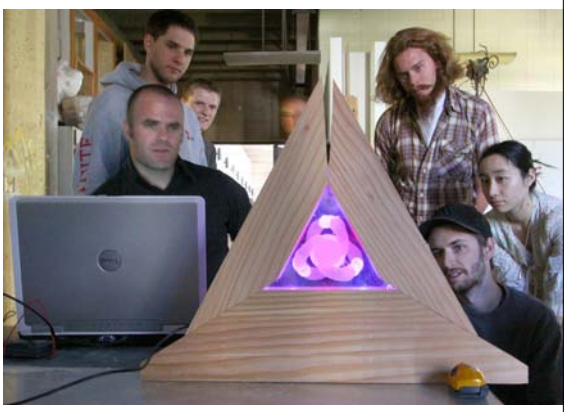
- Contains moving parts
  - Involving motion, sound, or light
- Often controlled by microcontrollers
  - Motors, actuators, transducers...
- Often reactive to environment





Cross-Disciplinary Class

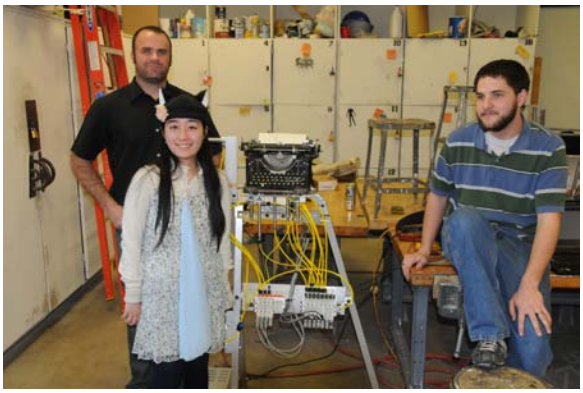
- Bring Art students and Computer Science and Engineering (CSE) students together
  - Design and build embedded-system-controlled kinetic art
  - Goal is benefit for both groups of students



- Fundamental nature of ***Design***?
  - Design thinking vs. computational thinking?

Class Overview

- Basic reactive programming with embedded systems
  - Electronics fundamentals
  - Sensors and actuators as I/O



- Basic 3d art concepts
  - Formal elements: aesthetics, proportion, balance, tension
  - Material studies and mechanical linkages
- Studio-based instruction model

Class Overview

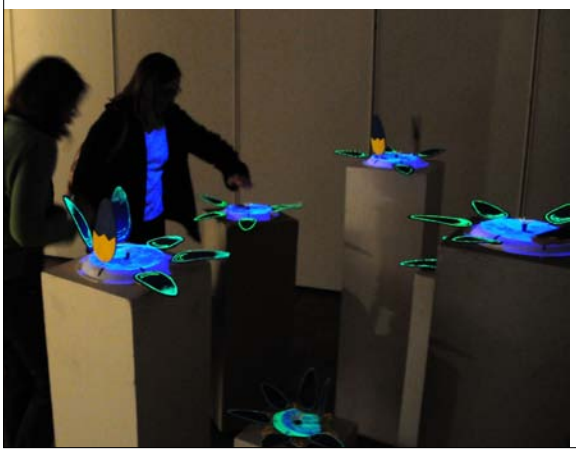
- Individual and group projects
  - Everybody tries everything individually
  - Also work in interdisciplinary teams

- Finish with a gallery show
  - 2009/2010: Invisible Logic
  - 2010/2011: Intersectio
  - Sp 2012: Drawing Machines
  - Sp 2013: Input/Artput

Intersectio

Enhancing Creativity

- Creative design and design-thinking: powerful concepts
  - One definition: enhanced creativity is generating many potential solutions instead of gravitating quickly to one



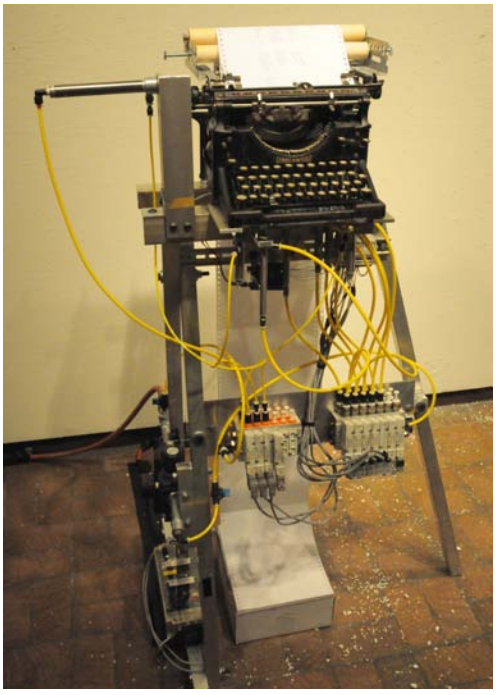
Kinetic art is serious stuff…

… but not regular CS projects

CS students have the freedom to explore without worrying about getting it "right"

HW Infrastructure

- Controllers – Arduino, PSoC, Thin Clients
- Sensors
  - Potentiometers/knobs, light, motion (PIR), distance, vibration (piezo), sound, temperature, etc.
- Actuators and transducers
  - LEDs , servos, DC motors, stepper motors, sound, etc.
- Other parts
  - LED drivers, transistors, resistors, diodes
  - LCD displays, SPI/I2C peripherals
  - Power supplies, soldering stations, wire, etc.



Drawing on Data

- Theme for this year's class
- The idea is to explore kinetic works that are based upon data
  - Mark making?
  - Environmental sensors?
  - Reactive art?
  - Data mining?

Sketchbooks

- You should start keeping a sketchbook
  - A page a day is a good target
    - Not every page needs to be a masterpiece…
  - Design ideas, inspiration, thoughts, etc.
  - Look at Carol Sogard's "Sketch School" for inspiration (link on class web site)
  - Assignment #1…

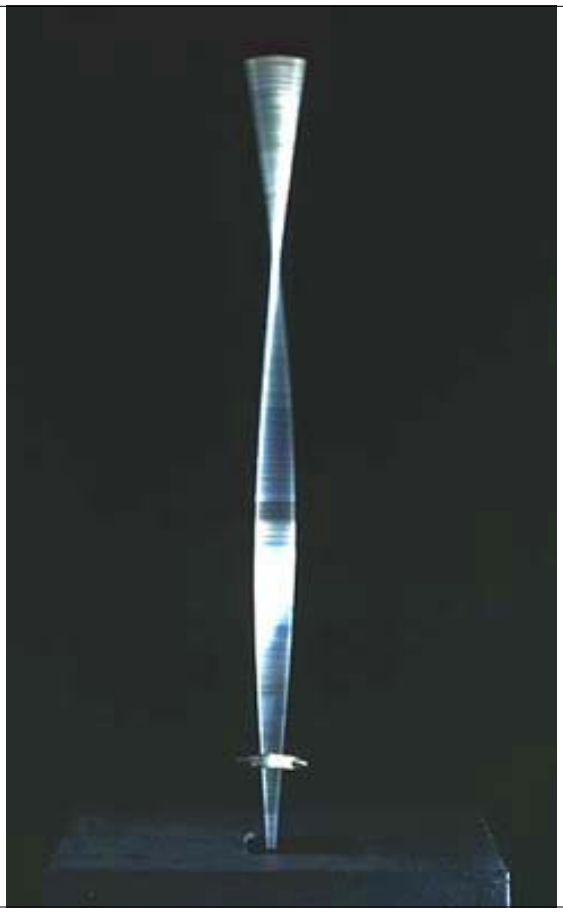
Background

- Short survey of kinetic art
  - The avant garde in the 1920's
  - Small steps in the 1950's
  - The computer age
  - Drawing Machines (separate lecture…)
- Class Examples

Naum Gabo

(1890-1977)

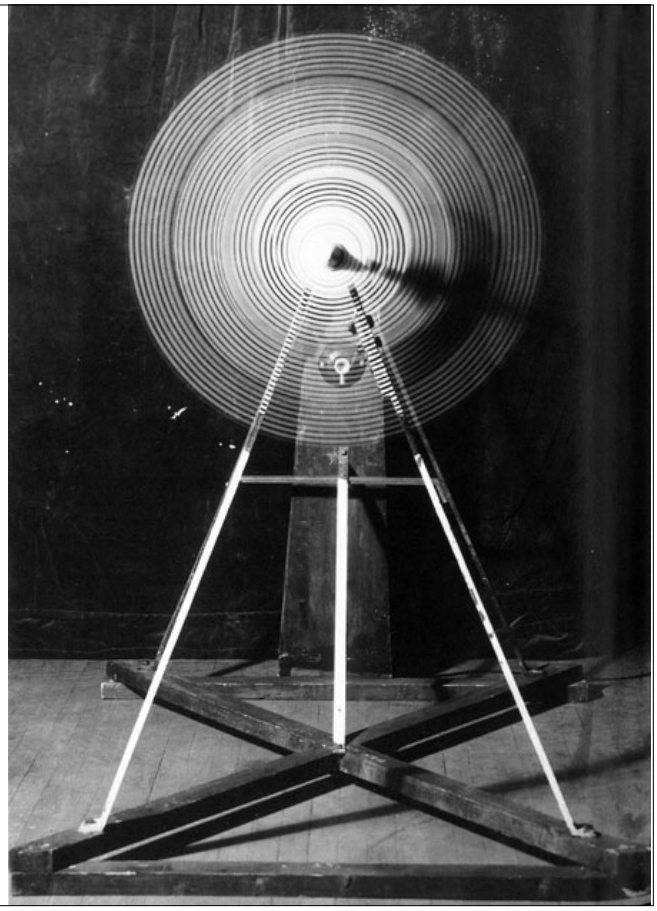
- Kinetic Construction (Standing Wave) 1919-1920



Marcel Duchamp

(1887 – 1968)

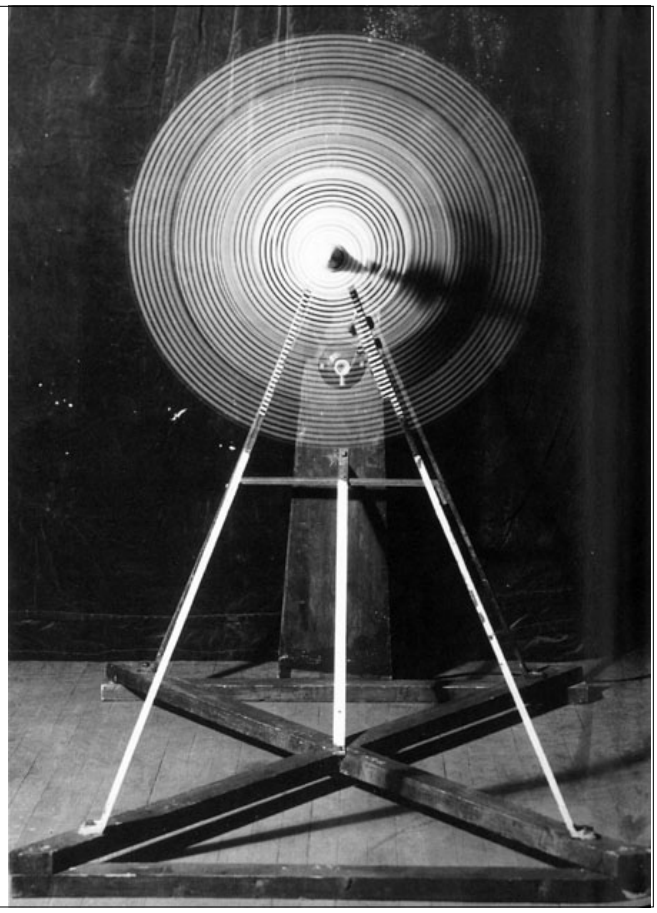
- Rotary Glass Plates
  1920
- Built with the help of
  Man Ray



Marcel Duchamp

(1887 – 1968)

- Rotary Glass Plates
  1920
- Built with the help of
  Man Ray
- Rumored to have almost
  killed Man Ray…



Marcel Duchamp

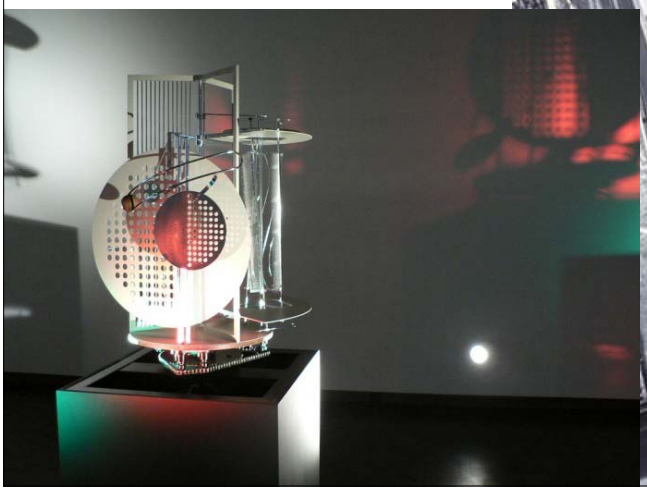
(1887 – 1968)

- Rotary Demisphere (Precision Optics) 1925

László Moholy-Nagy

(1895-1946)

- Light-Space Modulator (1922-30)



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(1895-1946)

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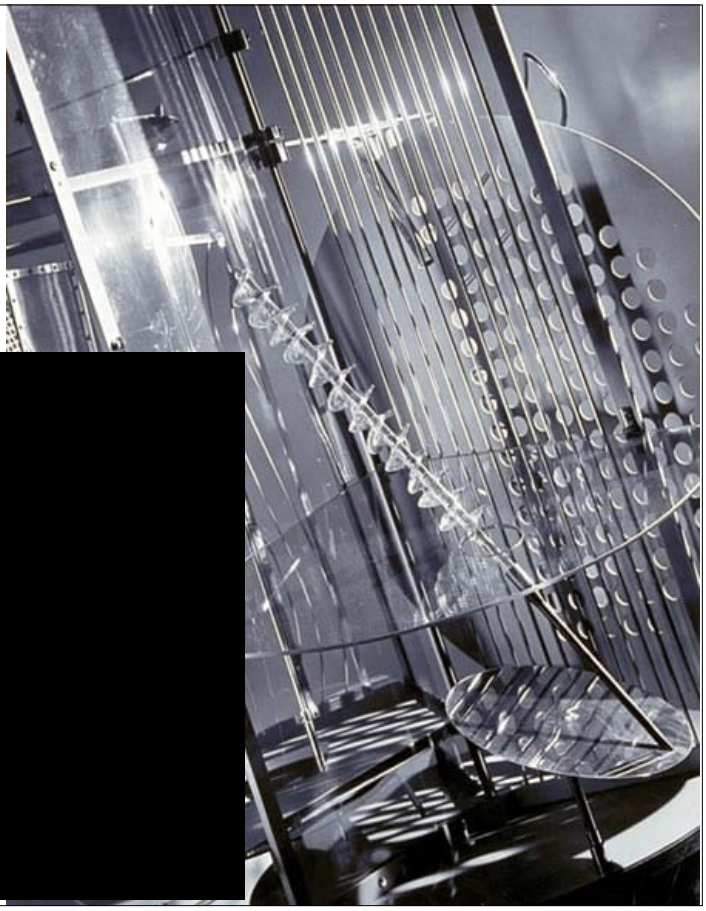
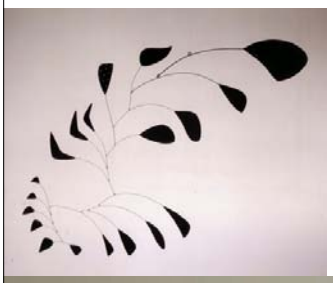
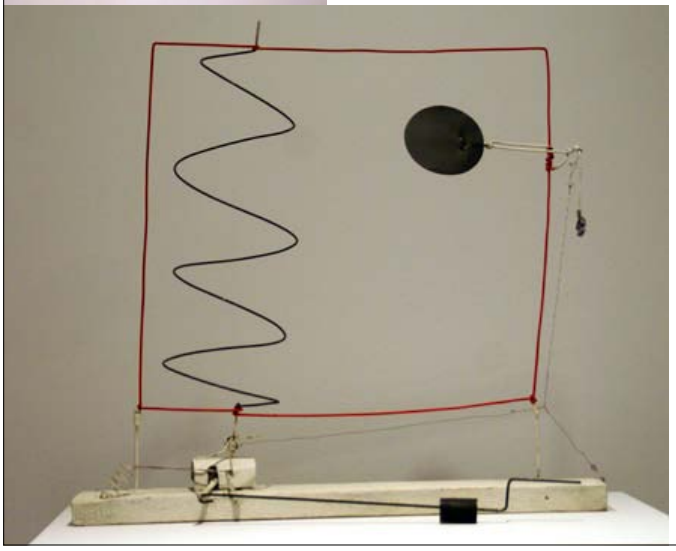


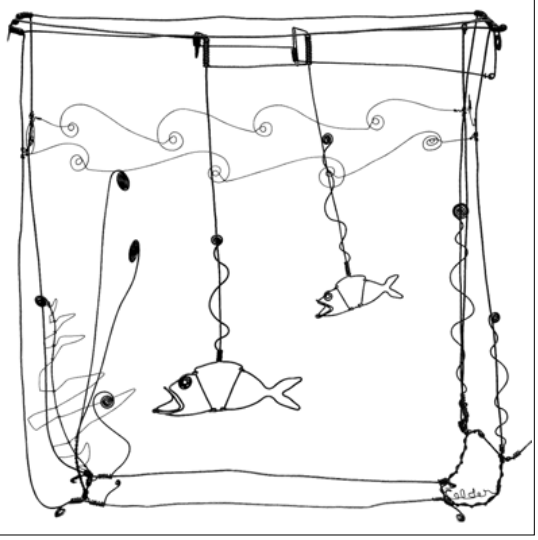
Alexander Calder



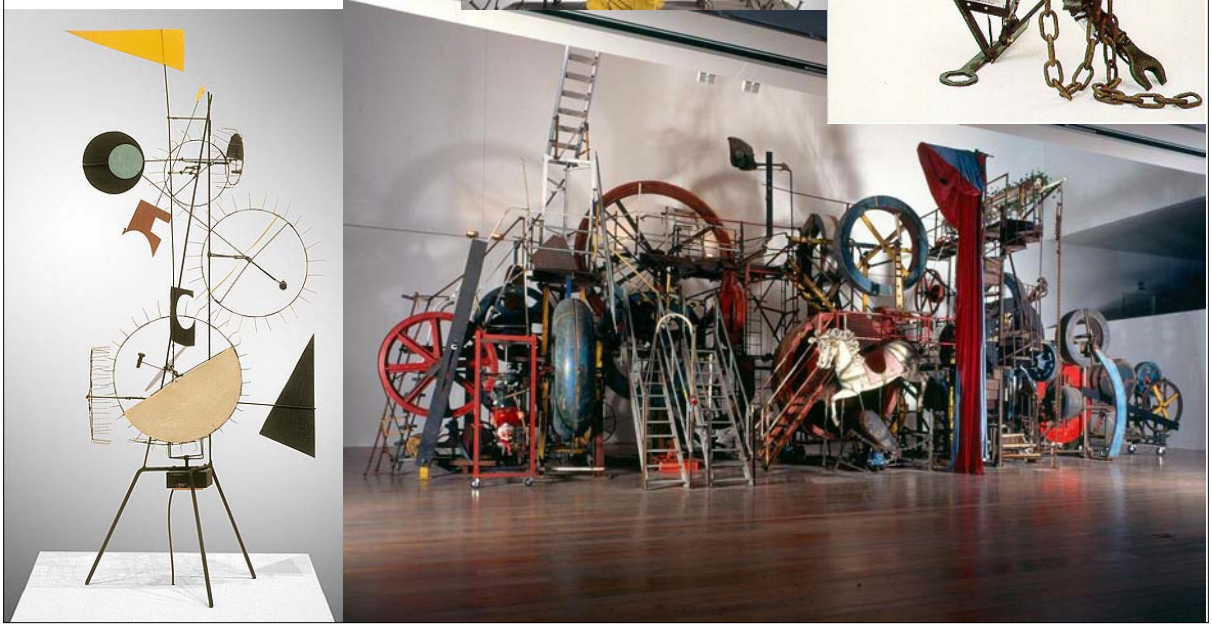
(1898 – 1976)

Mobiles and Stabiles
Wire and Circuses





Jean Tinguely
(1925 – 1991)



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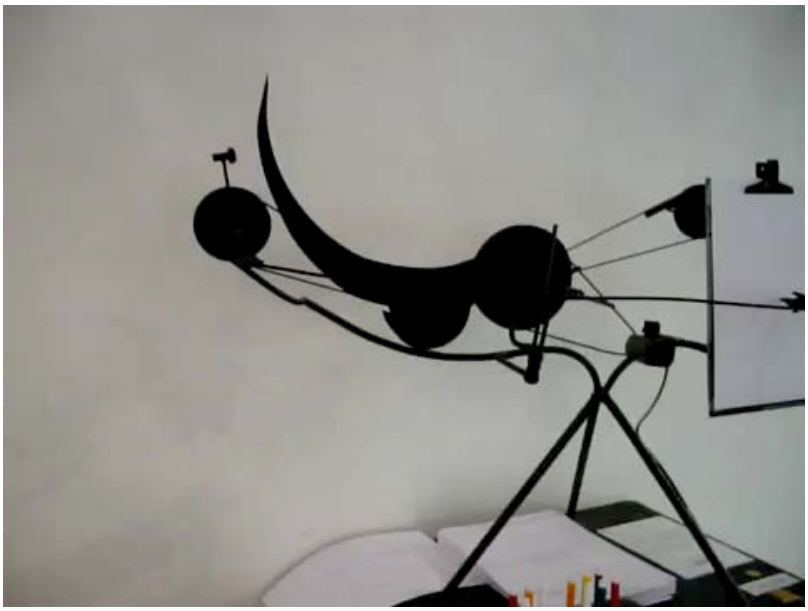
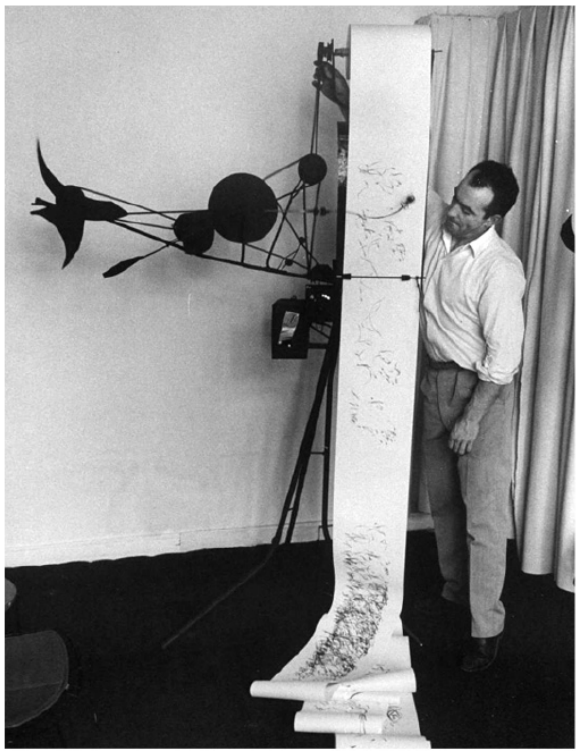


Metamatics

Jean Tinguely (1925 – 1991)

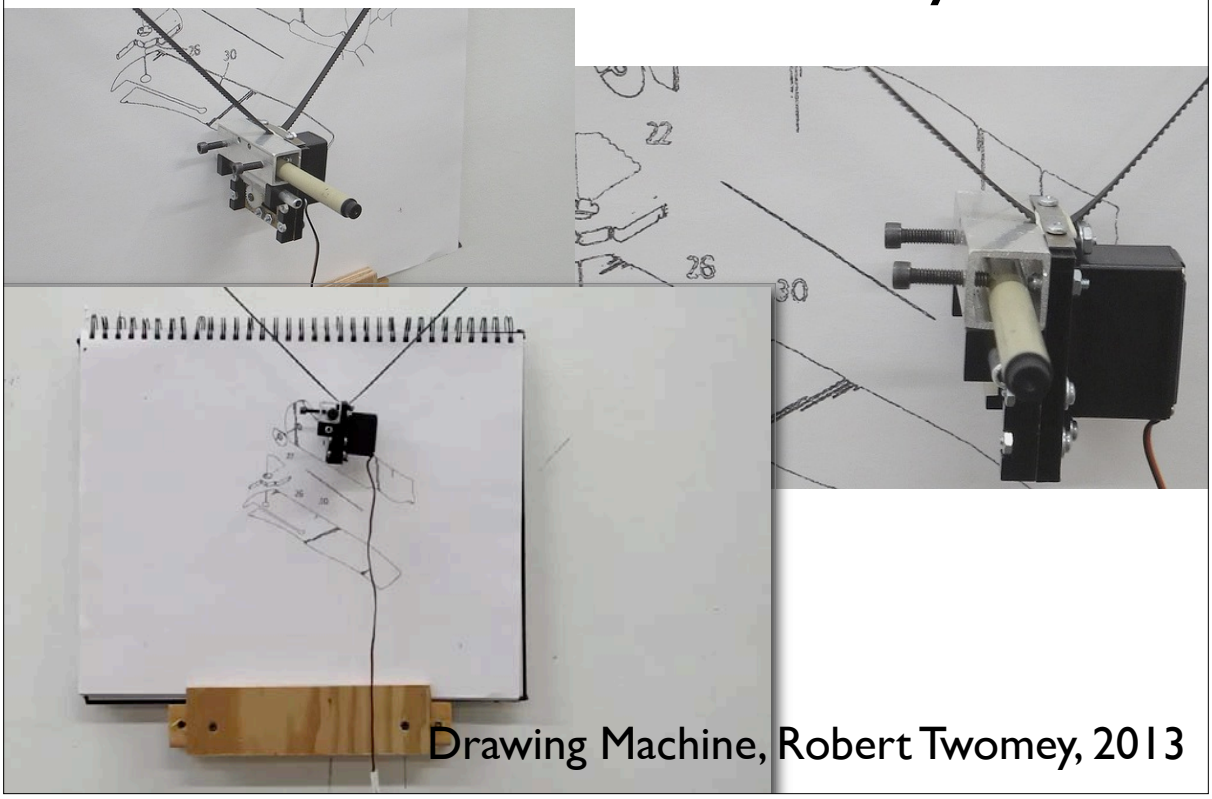


Metamatics

Jump ahead to the Computer Age

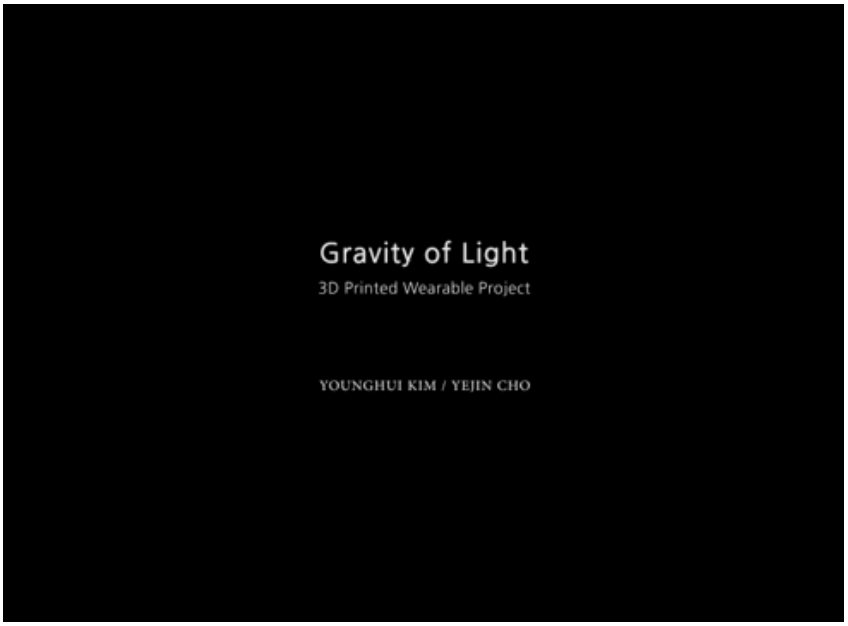
- Electronic control
  - microprocessors or discrete electronics
- Mechanical actuators
  - motors, servos, relays, solenoids, etc.
  - speakers, buzzers, other noise makers
- Lights
  - LEDs, light bulbs, EL wire, etc.
- Sensors to interact with the viewer
  - distance, movement, sound, temperature, vibration, etc.

SIGGRAPH Art Gallery

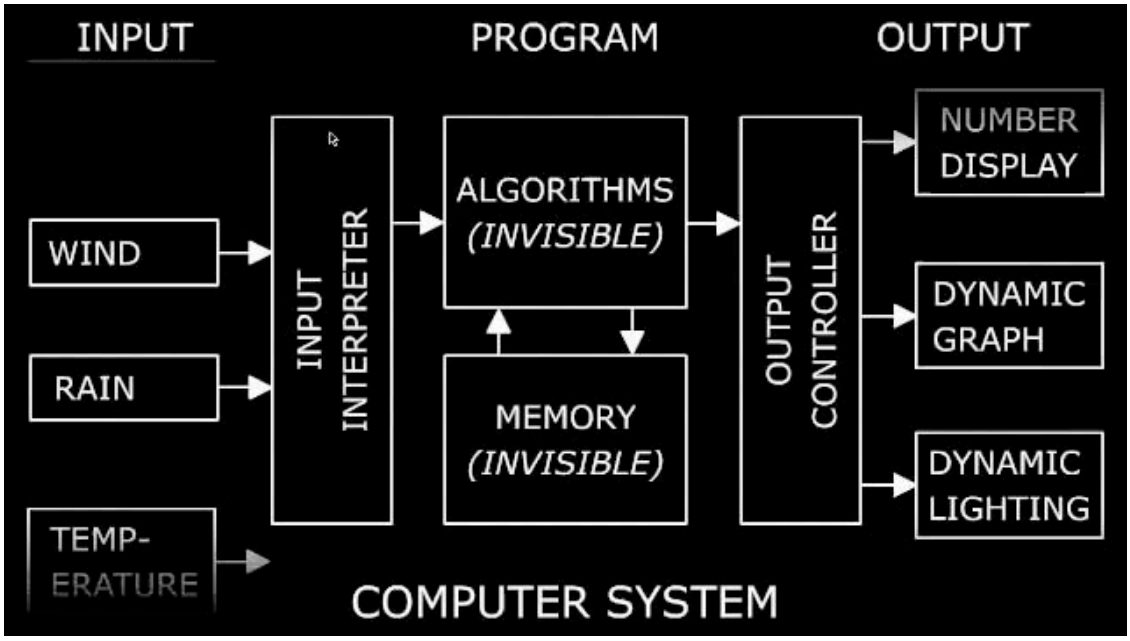


Drawing Machine, Robert Twomey, 2013

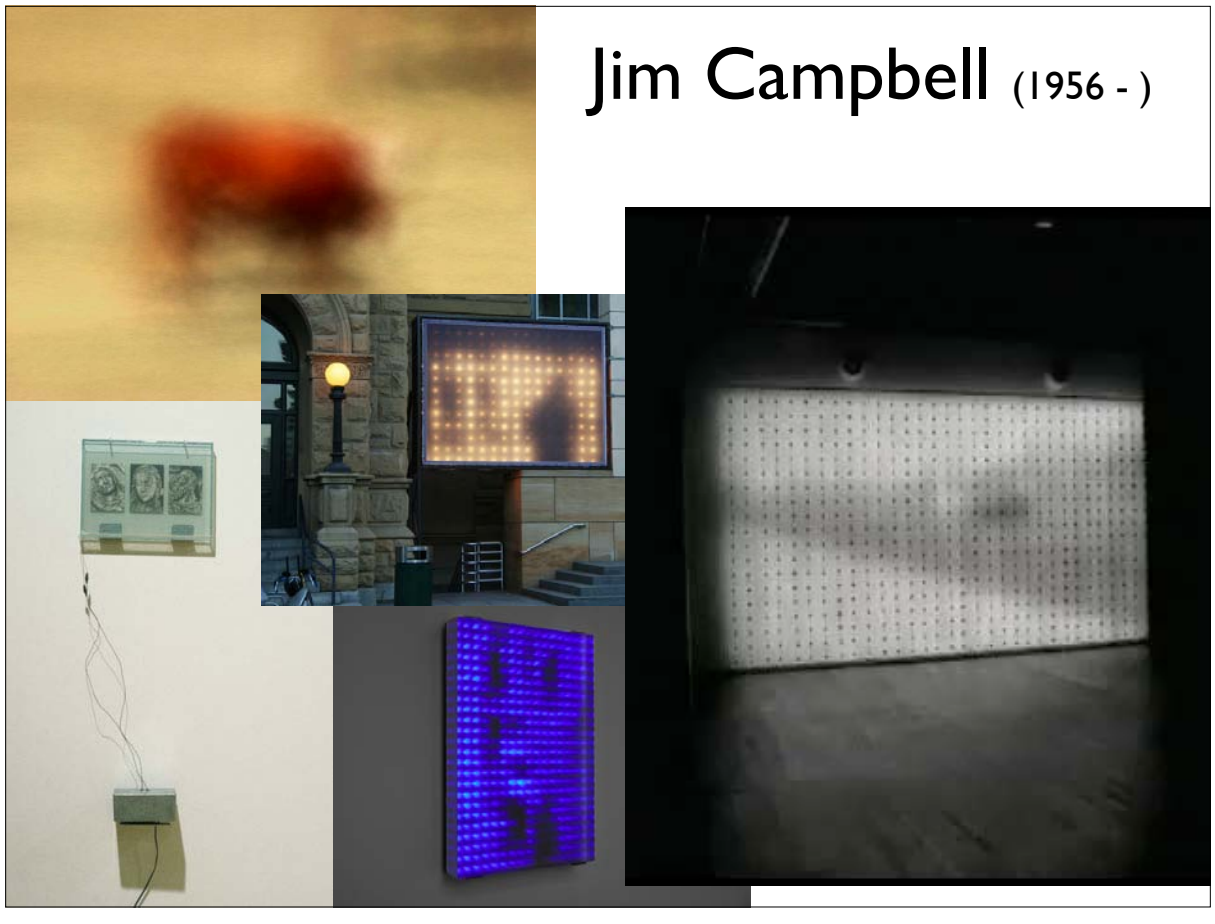
CHI Interactivity



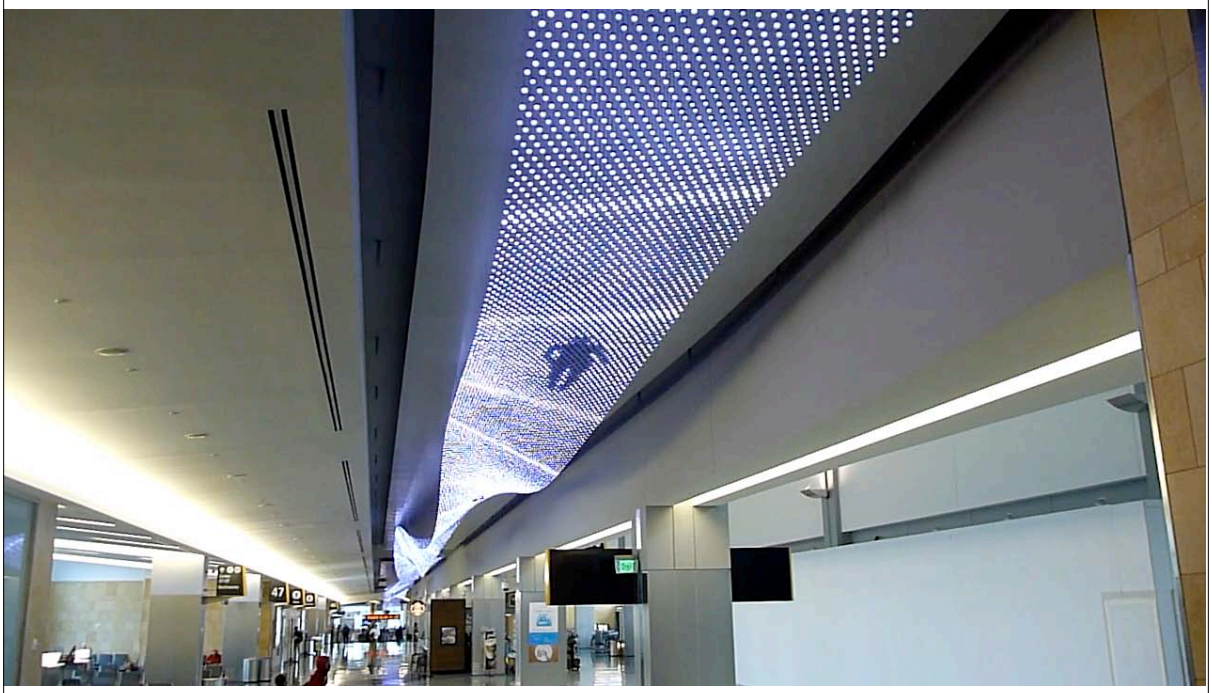
Jim Campbell's Algorithm



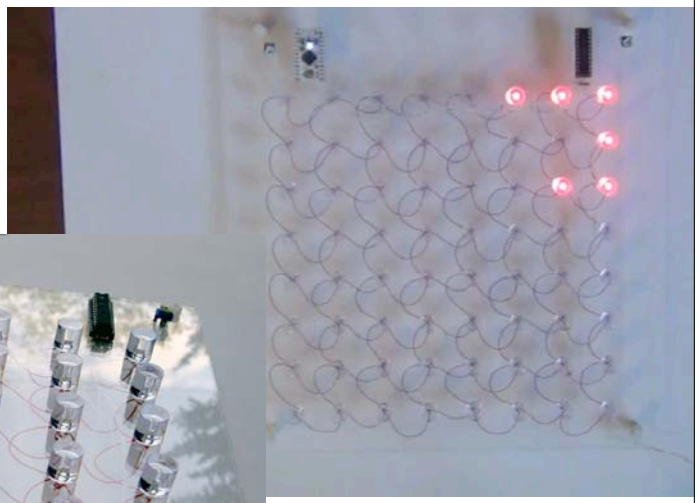
Jim Campbell (1956 -)

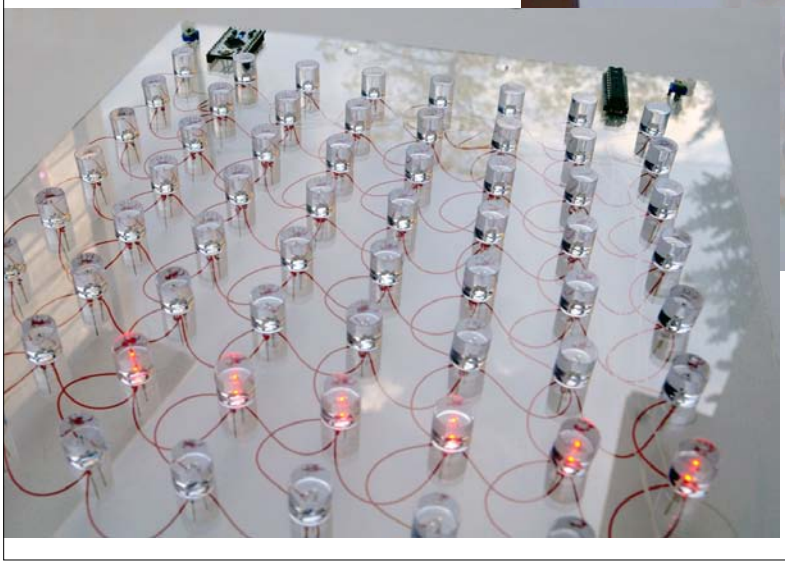


Jim Campbell

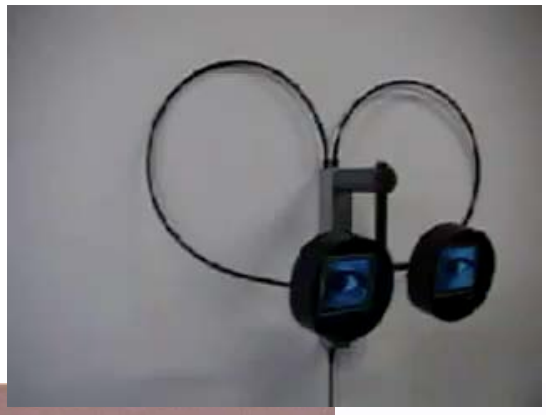


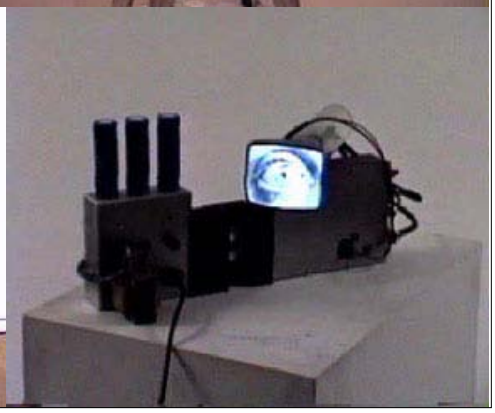
Serpente Rosso





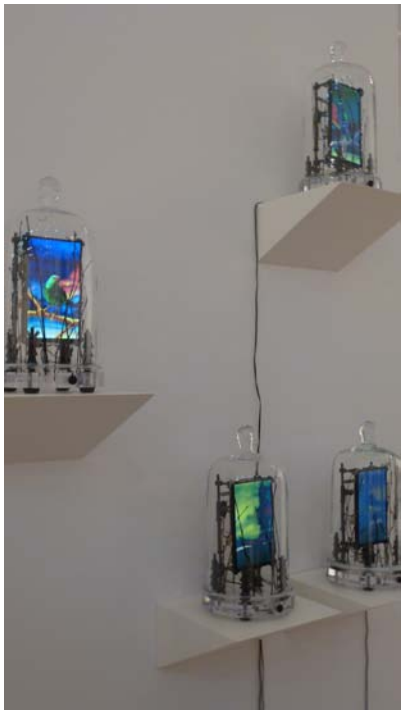
Alan Rath (1959 -)

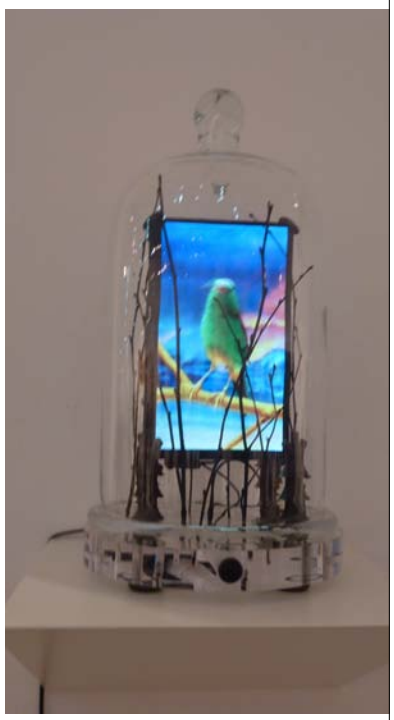




Alan Rath (1959 -)

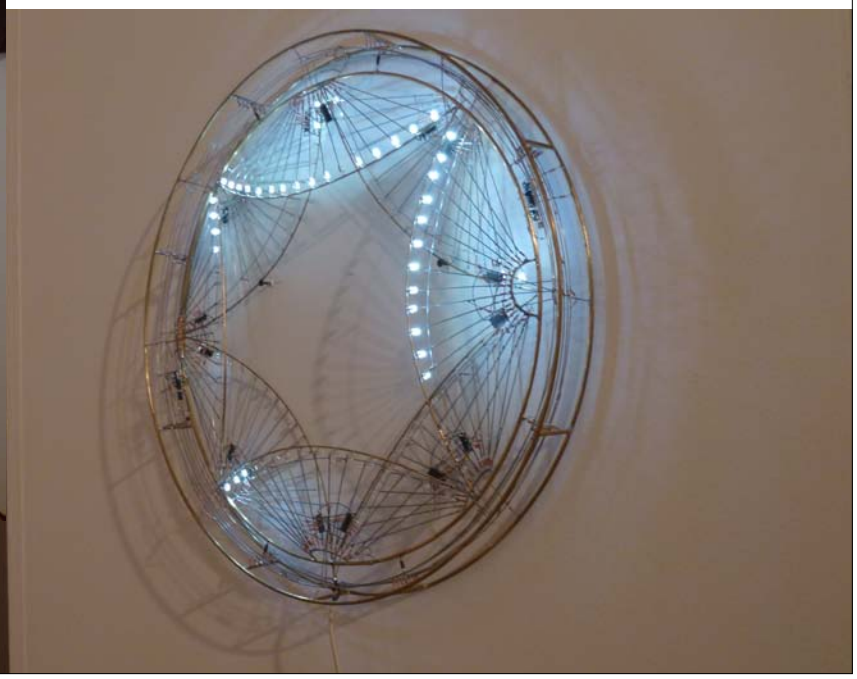
Art Basel, 2013





Alain Le Boucher

Art Basel, 2013



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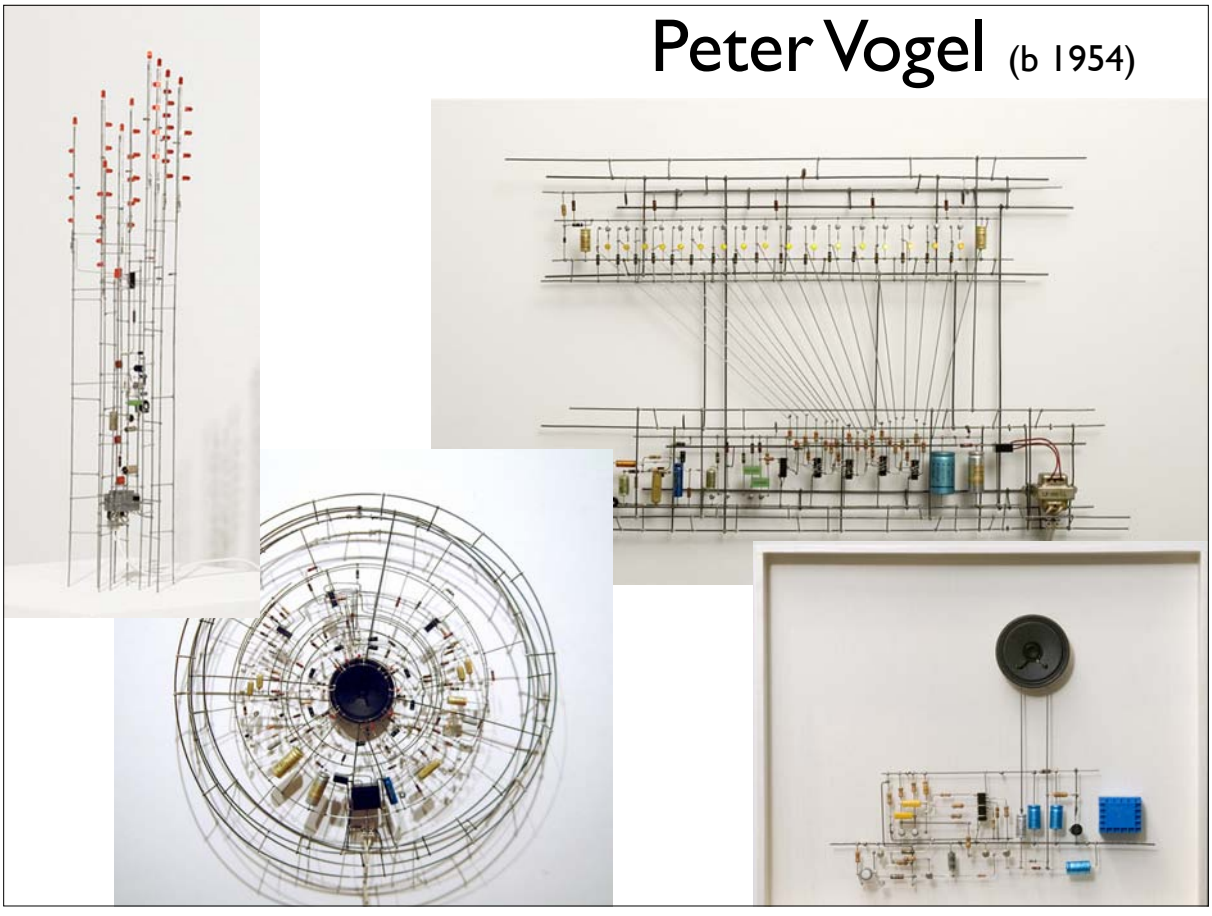
Peter Vogel (b 1954)

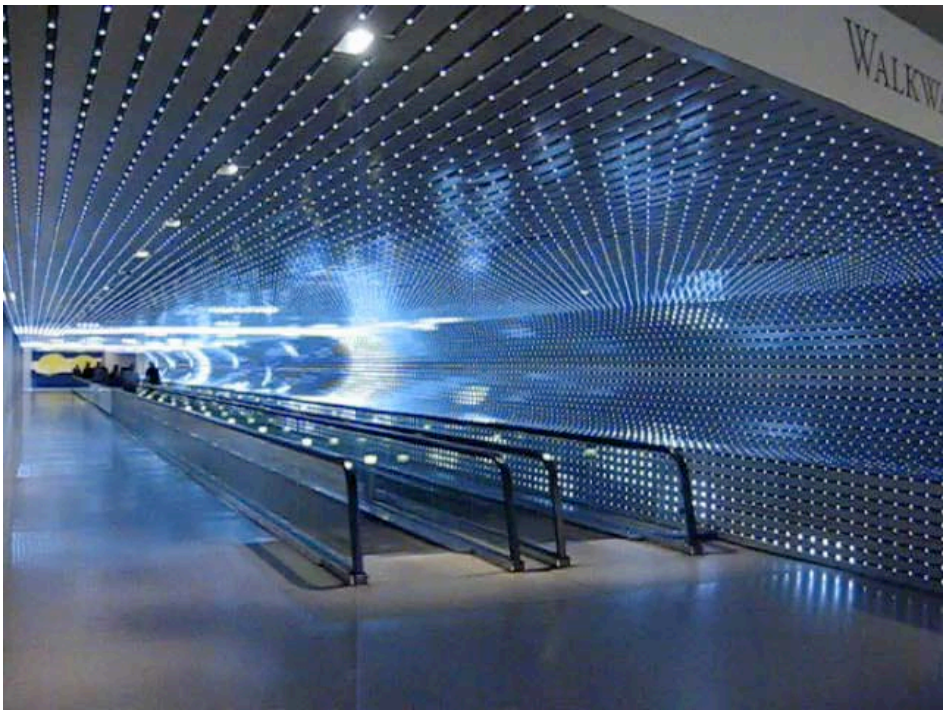


Peter Vogel (b 1954)

Soundwall Performance II

Jack Dollhausen

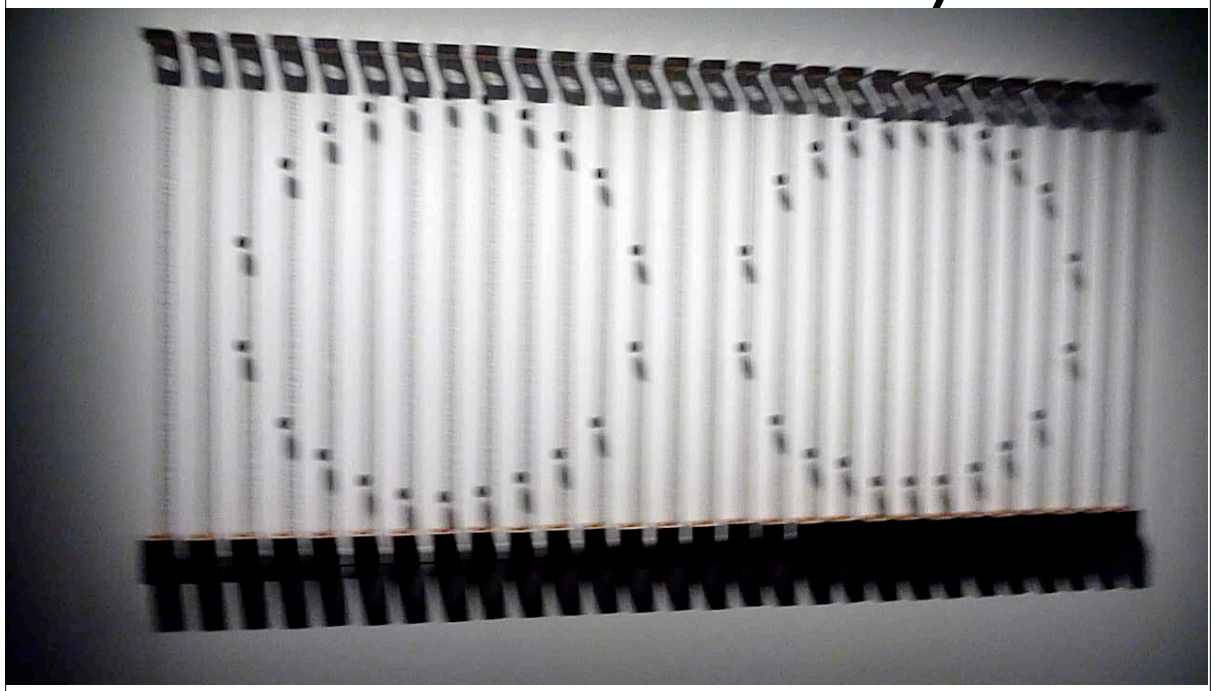
Leo Villareal (b1967)



Leo Villareal (b1967)

Jenny Holzer (b1950)

SIGGRAPH Art Gallery



SIGGRAPH Art Gallery

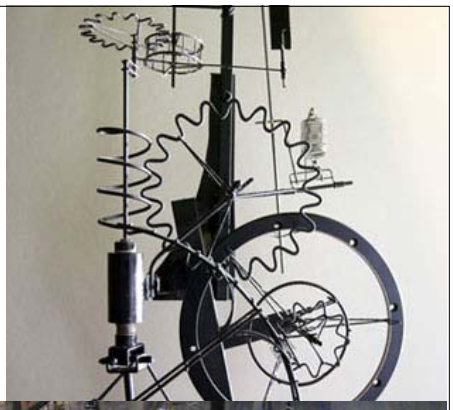
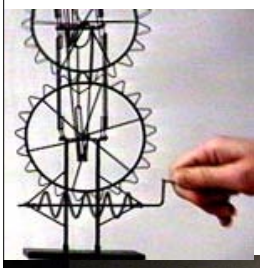
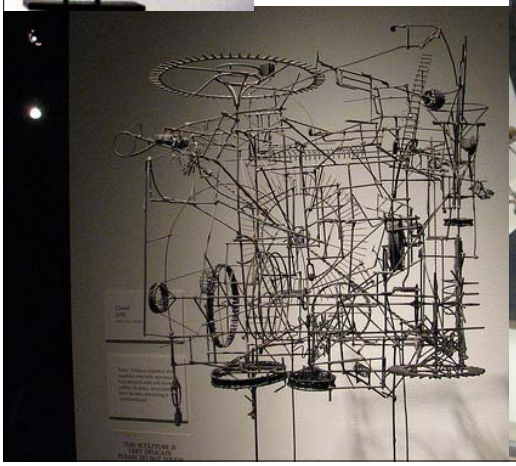
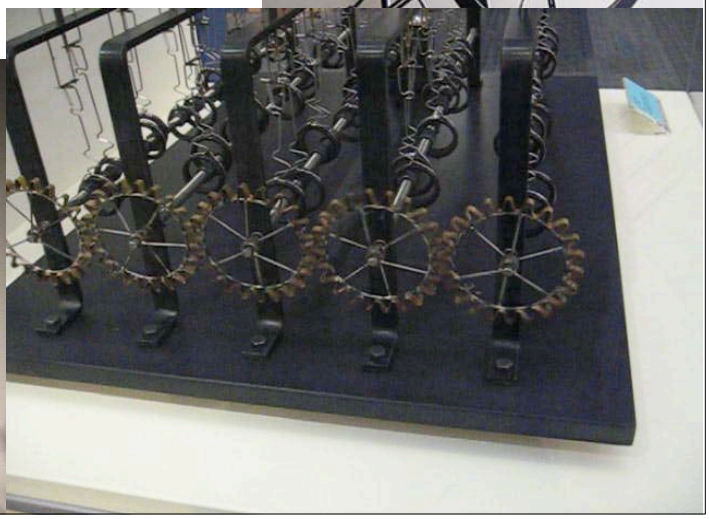
SIGGRAPH Art Gallery

Daniel Rozin (1961 -)



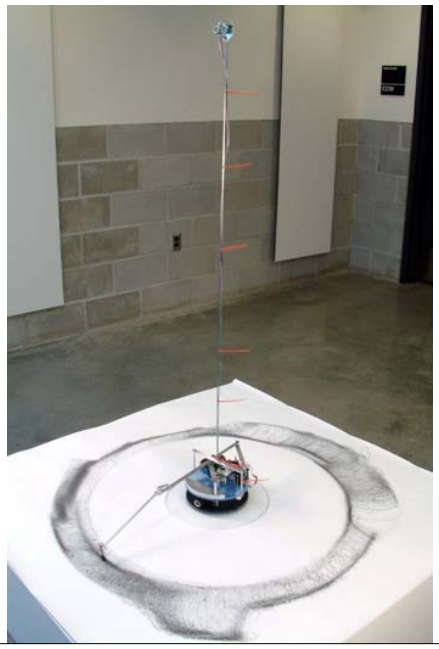


Arthur Ganson (1955 -)

David Bowen

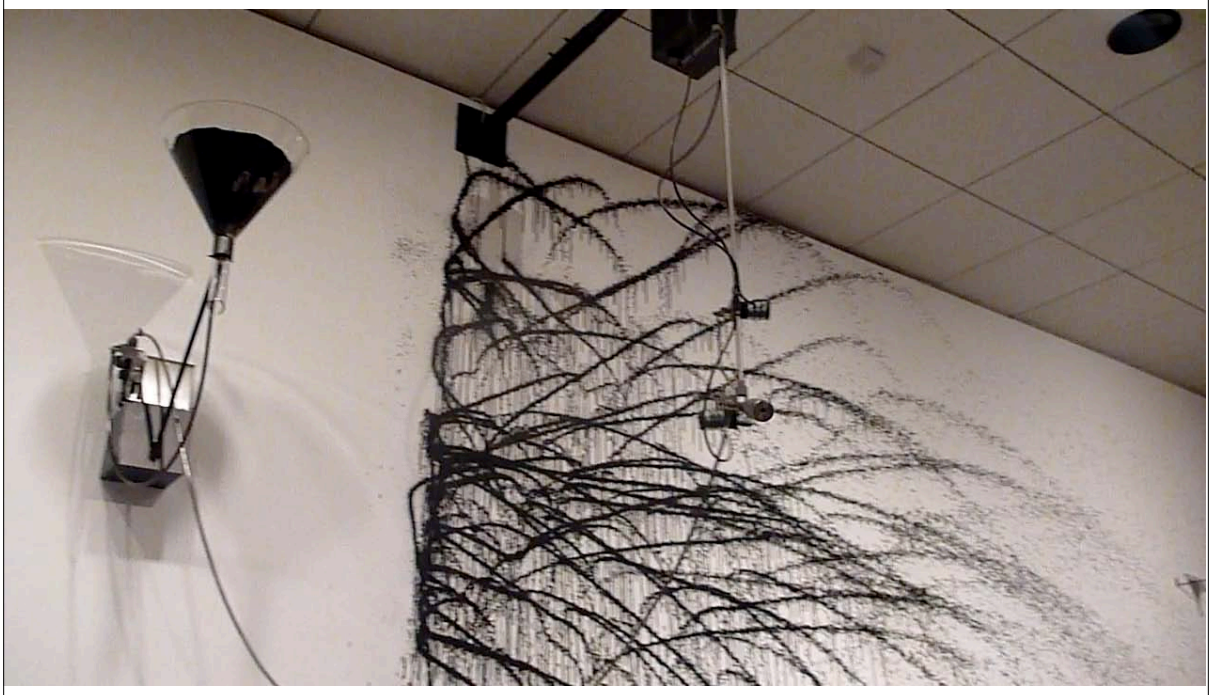
University of Minnesota, Duluth



David Bowen

Tele-present wind

Rebecca Horn



Patrick Tresset

Jim Pallas

Hylozoic Veil at The Leonardo

Philip Beesley

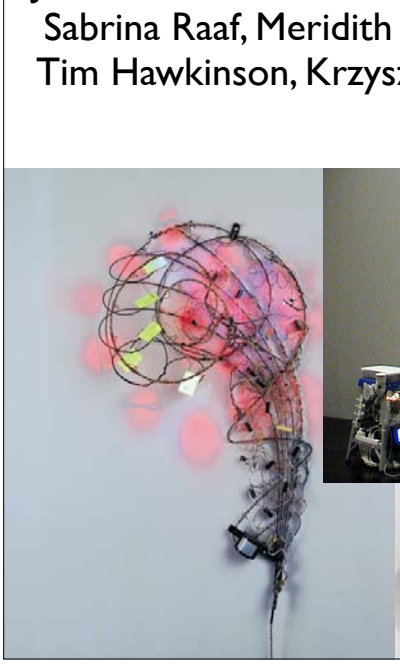
Hylozoic Veil at The Leonardo

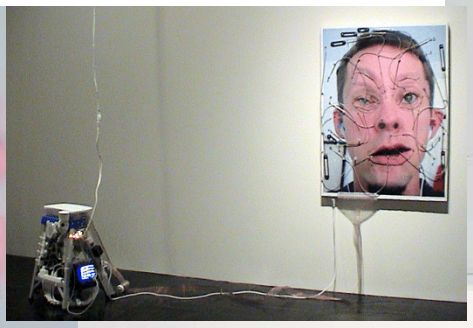
07

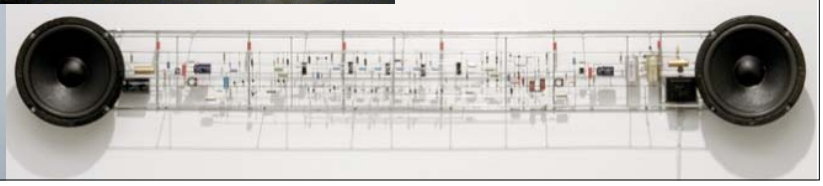
Philip Beesley

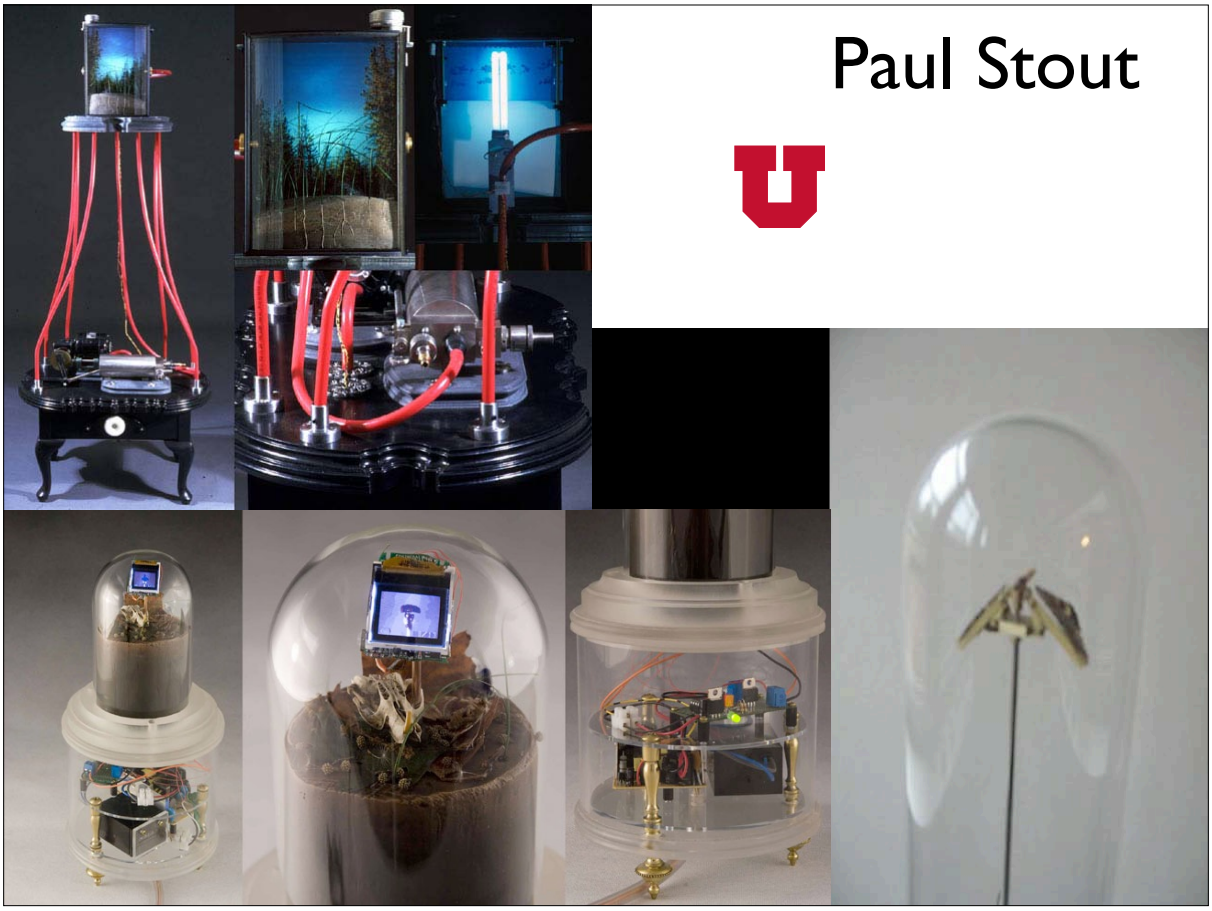
Lots of others…

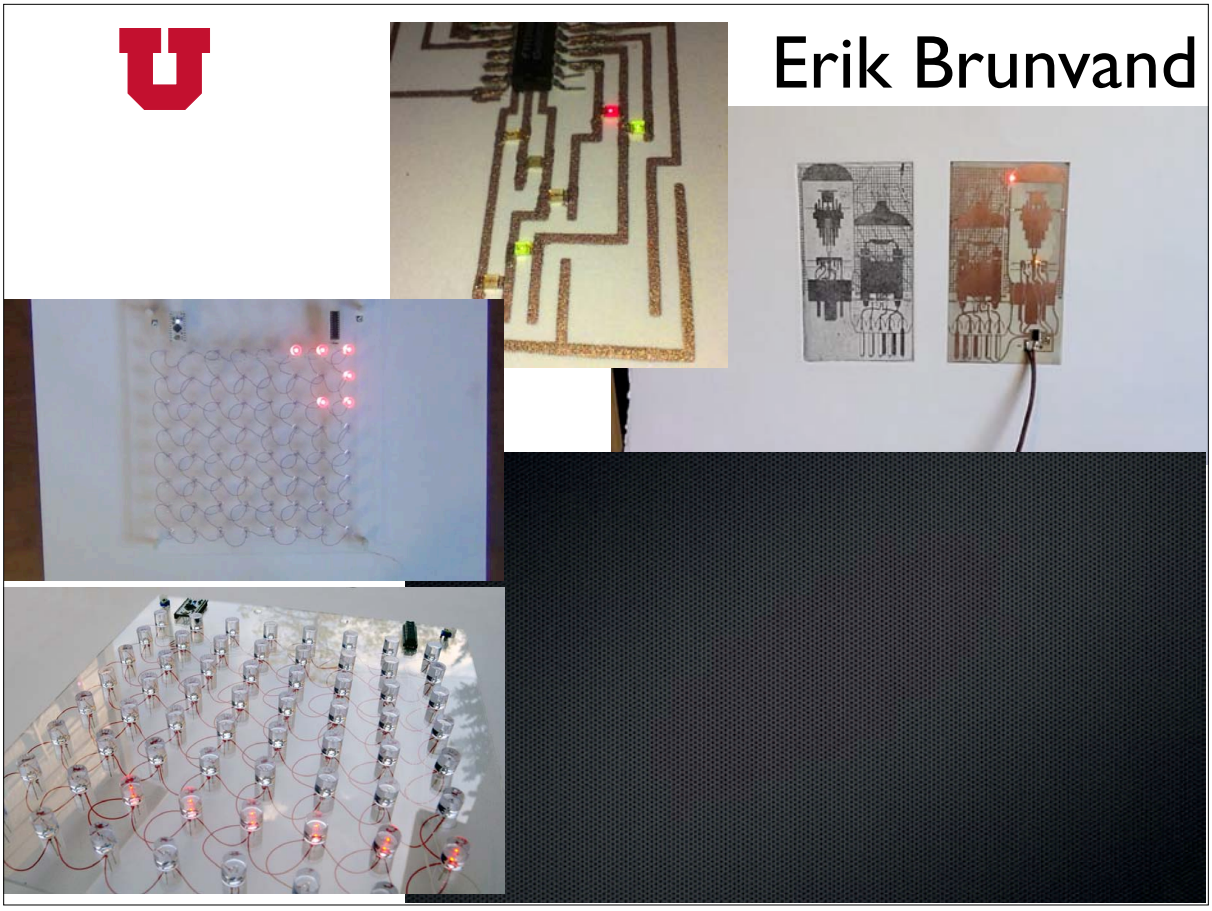
Jack Dollhausen, Peter Vogel, Rebecca Horn, Sabrina Raaf, Meridith Pingree, Roxy Paine, Tim Hawkinson, Krzysztof Wodiczko, etc…








Paul Stout


Erik Brunvand

Examples of Student Projects

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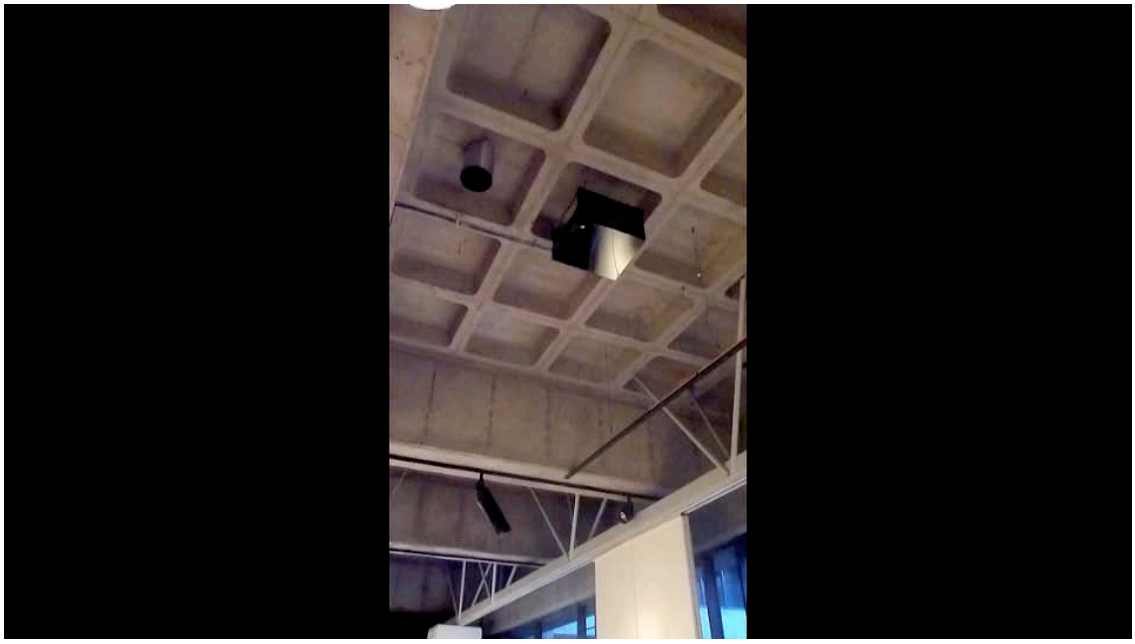

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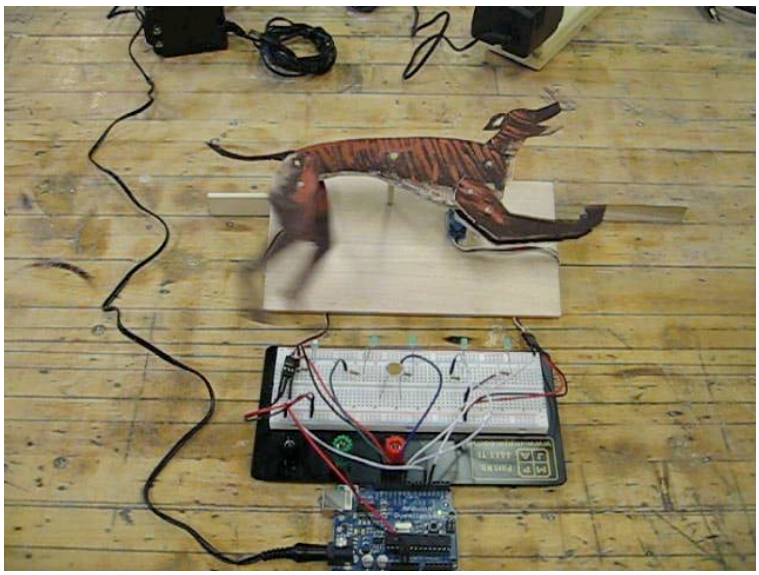
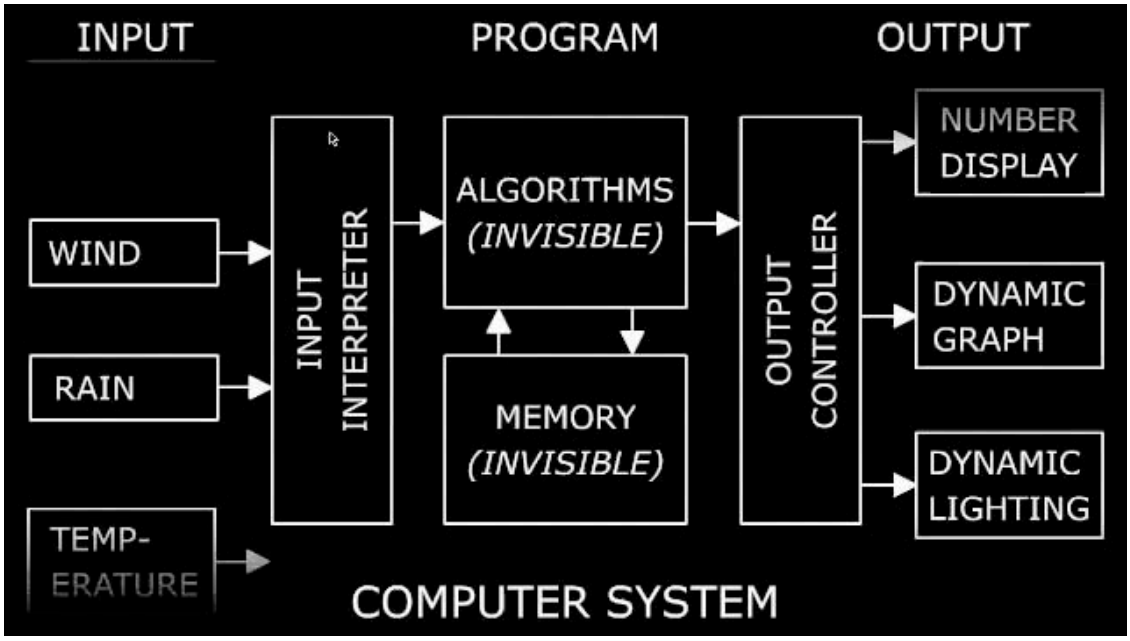


Going Forward

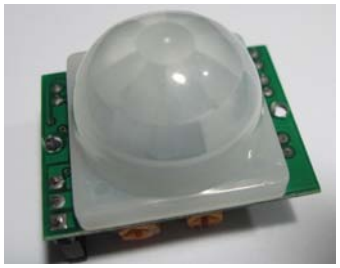
- Embedded systems and kinetic art is a natural collaboration
  - Exploration of fundamental design concepts
  - Design-thinking is a natural complement to computational-thinking
- Collaboration is good stuff
  - Both groups of students benefit from working with each other
  - Cross-college collaboration – just the beginning!

Jim Campbell's Algorithm



Input Sensors

- Switches
- Resistive sensors
  - Get analog values based on sensing input
  - light, temperature, knobs, flex, etc
- Proximity/motion sensing
  - PIR, distance, etc.

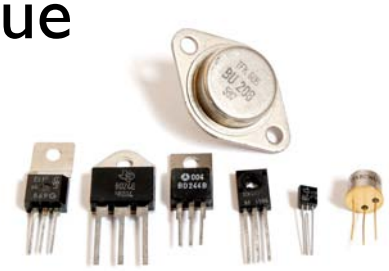


Output Transducers

- Motion
  - Motors - DC, Stepper
  - Servos
- Light
  - LED, bulbs, etc.
- Sound
  - Generated, recorded, physical, etc.

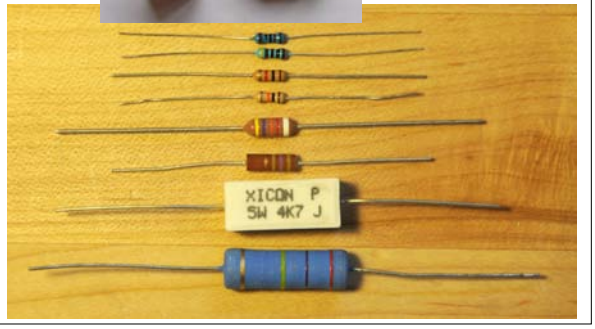
Electronic Glue

Power supplies



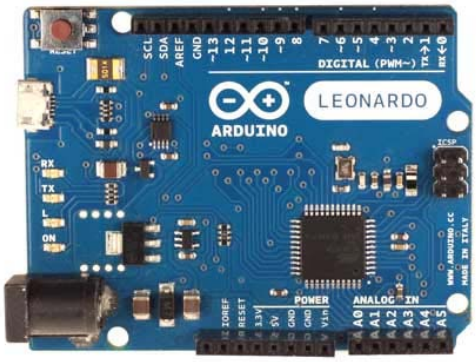
- Transistors
  - used as electronic switches for medium power devices

- Relays
  - used as electronic switches for high power devices
- resistors, capacitors, wires, etc.

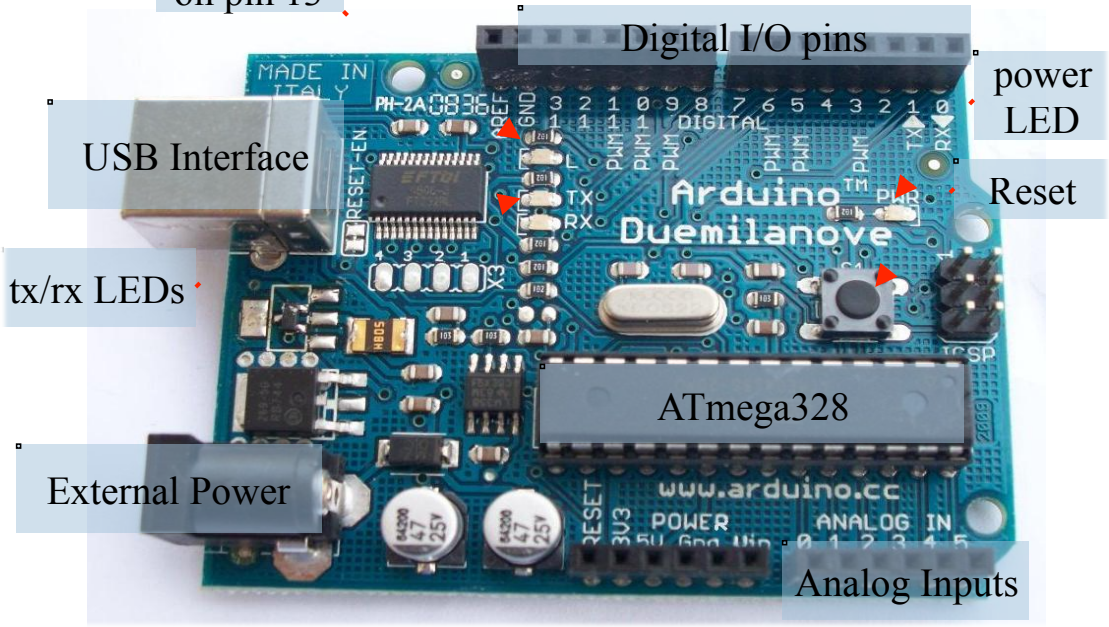


Computer Control

- Microprocessor
  - receive inputs
  - do some computation
    - You'll have to write some programs…
  - send signals to the outputs



Computer Control



Other Resources

- Wood and metal shop in Art department
- Metal shop in the Engineering building
  - We can schedule orientations…
- Laser cutter in the Art department
  - VERY cool machine – can cut many things like plastic, paper, and plywood
- Water jet cutter in Engineering
  - VERY cool machine that can cut almost anything
  - Requires training – costs $10 for training class
  - Costs $47/hour (but most jobs take only minutes)

Arduino

- Based on the AVR ATmega328p chip
  - 8 bit microcontroller @ 16MHz
  - 32k flash for programs
  - 2k RAM, 2k EEPROM, 32 registers
  - 14 digital outputs (PWM on 6)
  - 6 analog inputs
  - Built-in boot loader
  - Powered by USB
    or by external power

Arduino

8-bit RISC CPU – 16MHz

32 registers

32k Flash, 2k SRAM, 1k EEPROM

3 8-bit I/O ports

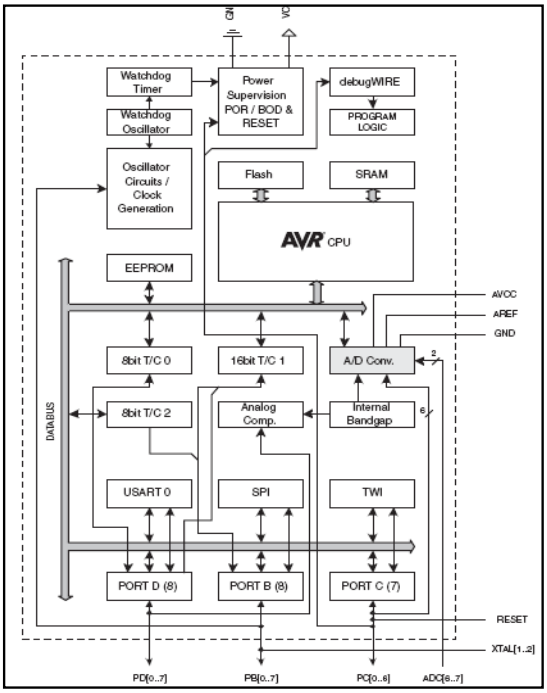
6 ADC inputs

2 8-bit timers

1 16-bit timer

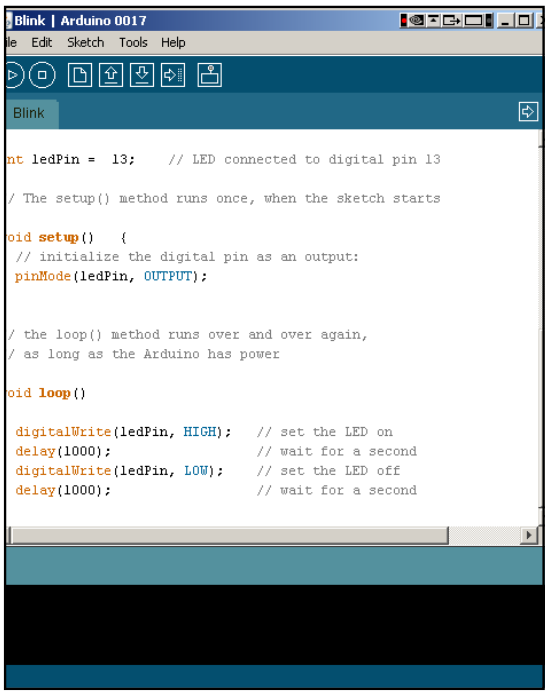
USART

SPI/TWI serial interfaces



Arduino

- Open-source programming environment
- Arduino language is based on C
  - Actually, it *is* C/C++
  - Hiding under the hood is gcc-avr
  - But, the Ardiuino environment has lots of nice features to make programming less scary...



More Arduino Info?

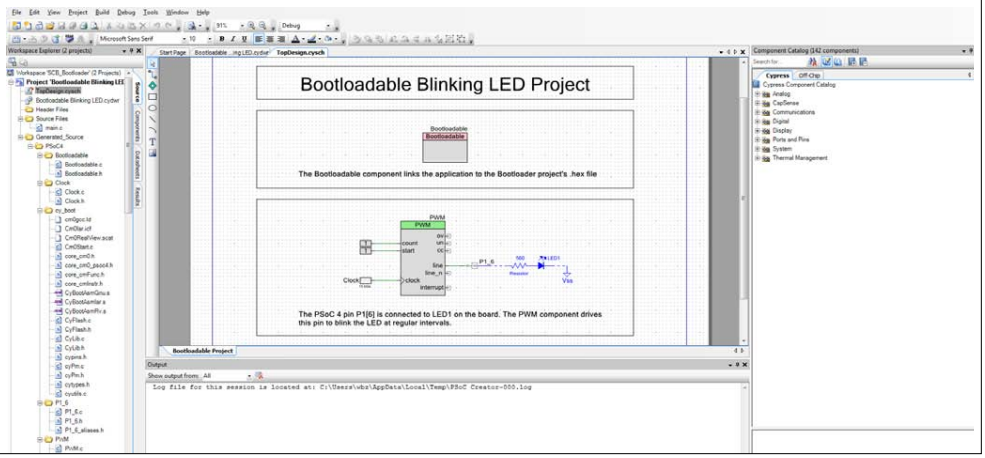
- www.arduino.cc
  - Main Arduino project web site
- www.arduino.cc/playground/Main/HomePage
  - "playground" wiki with lots of users and examples
- www.freeduino.org
  - "The world famous index of Arduino and Freeduino knowledge"

Cyprus PSoC4

- Based on 32-bit ARM Cortex M0 @ 48MHz
  - 36 GPIO pins (some with special functions)
  - CapSense built in
  - 12-bit, 1Msps ADC
  - 32kB flash, 4kB SRAM
  - 2 programmable op amps
  - 4 16-bit timer/counter PWM blocks
  - 4 programmable logic blocks called universal digital blocks, (UDBs), each with 8 Macrocells and data path

Cyprus PSoC Creator SW

- Windows-based design environment for PSoC
  - Free - but, I haven't played with it much…
  - It appears to be quite powerful, but a bit harder to use than Arduino…



Cyprus PSoC Info

- Main PSoC4 web site
  - http://www.cypress.com/psoc4/?source=CY-ENG-HEADER
- We have the PSoC 4200 prototyping kits
  - http://www.cypress.com/?rid=92146
- Here's the PSoC Creator download site (you'll have to register)
  - http://www.cypress.com/psoccreator/
- Here are a bunch of PSoC example projects
  - http://www.cypress.com/?rID=83212

More Resources for this Class

- We have some supplies for the class
  - Arduino and PSoC boards
  - A few HP Thin Clients that can run Linux
  - sensors of various different types
  - motors and servos
  - LEDs and LED controllers
- You should expect to have to buy a few more parts on your own to complete your project though...

Complete Art Piece

- Kinetic concept in a well-conceived and constructed artifact
  - For this semester, think about how to incorporate data
  - Make marks? Be reactive? Sense the environment?
- Traditional 3d materials
  - Wood, metal, plastic, wiring, and other structural materials
  - Unattended functioning (i.e. in gallery)
  - Consider maintenance and support issues too…

Contact

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  - elb@cs.utah.edu
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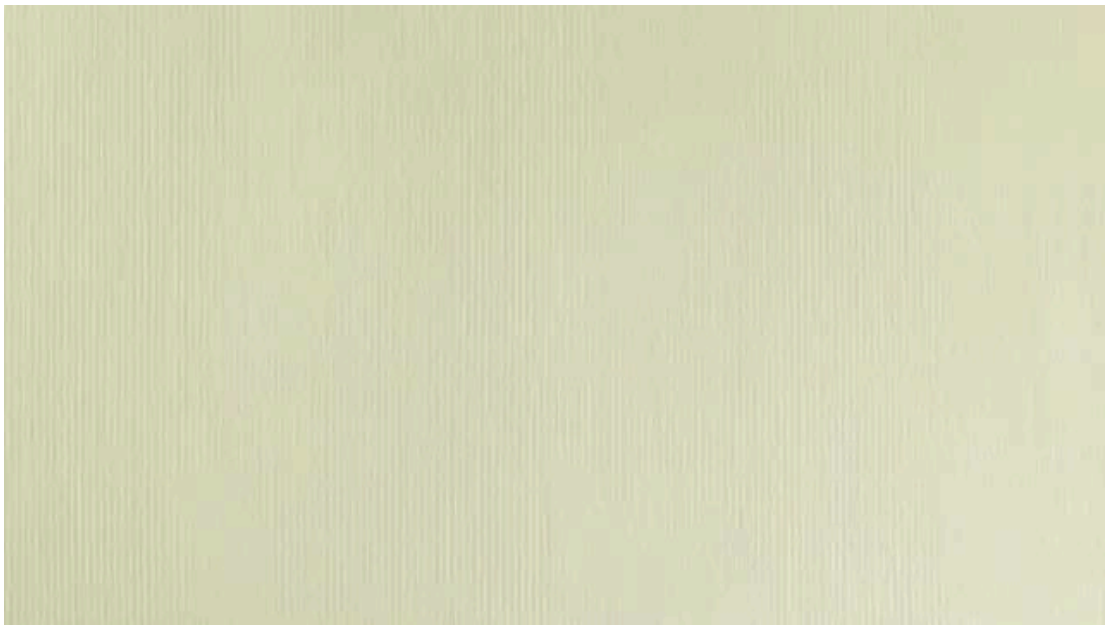
  - Paul.Stout@gmail.com

- www.eng.utah.edu/~cs5789

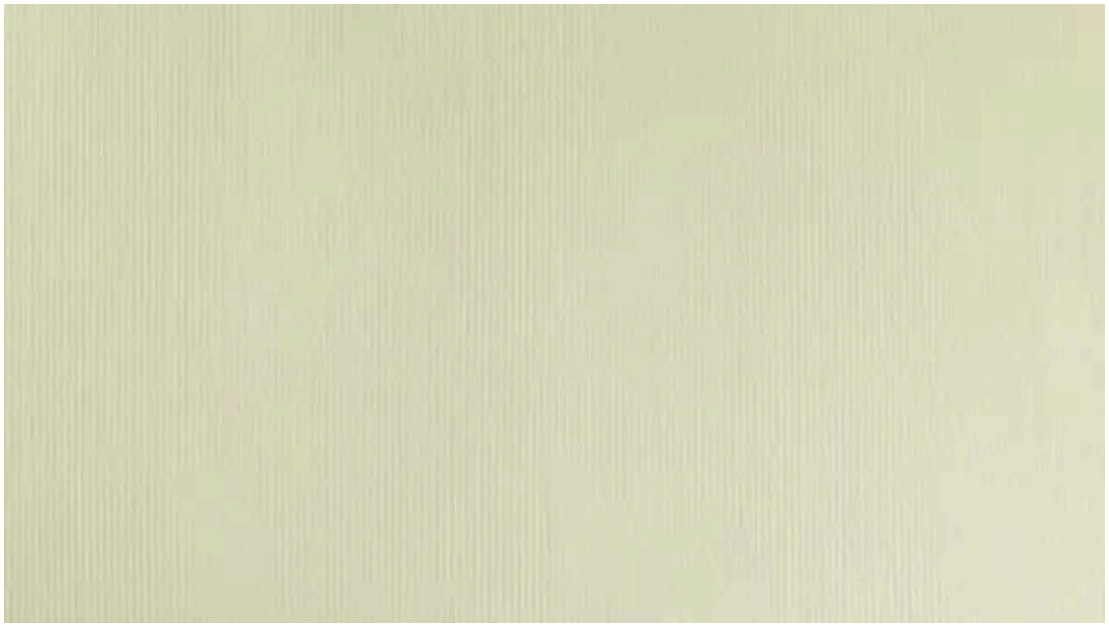
Extra Slides

- More examples of student projects

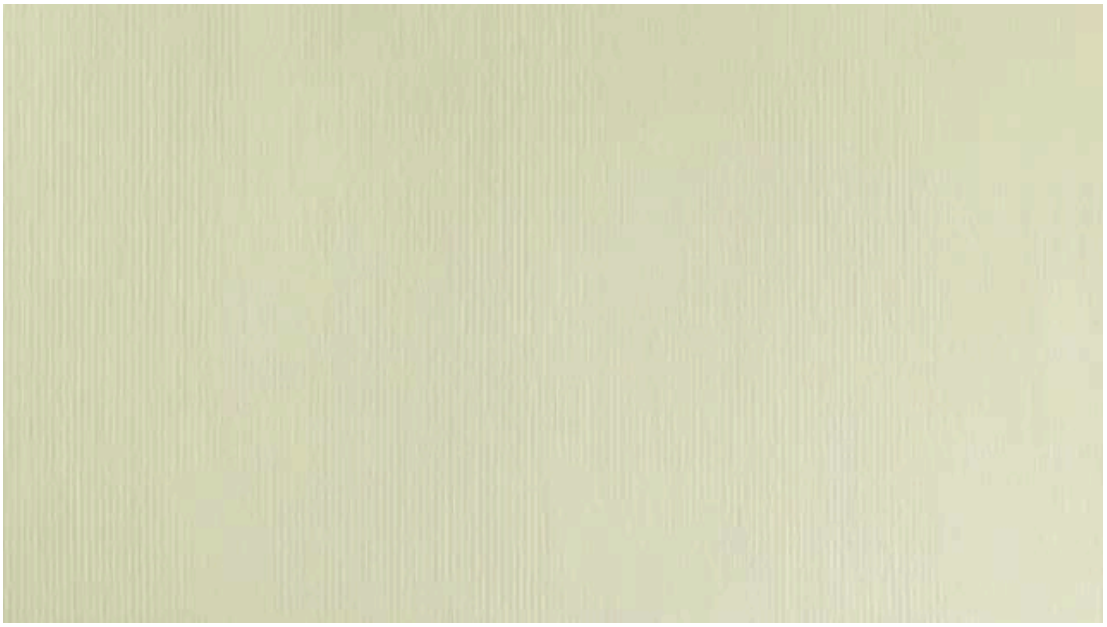
Examples of Student Projects



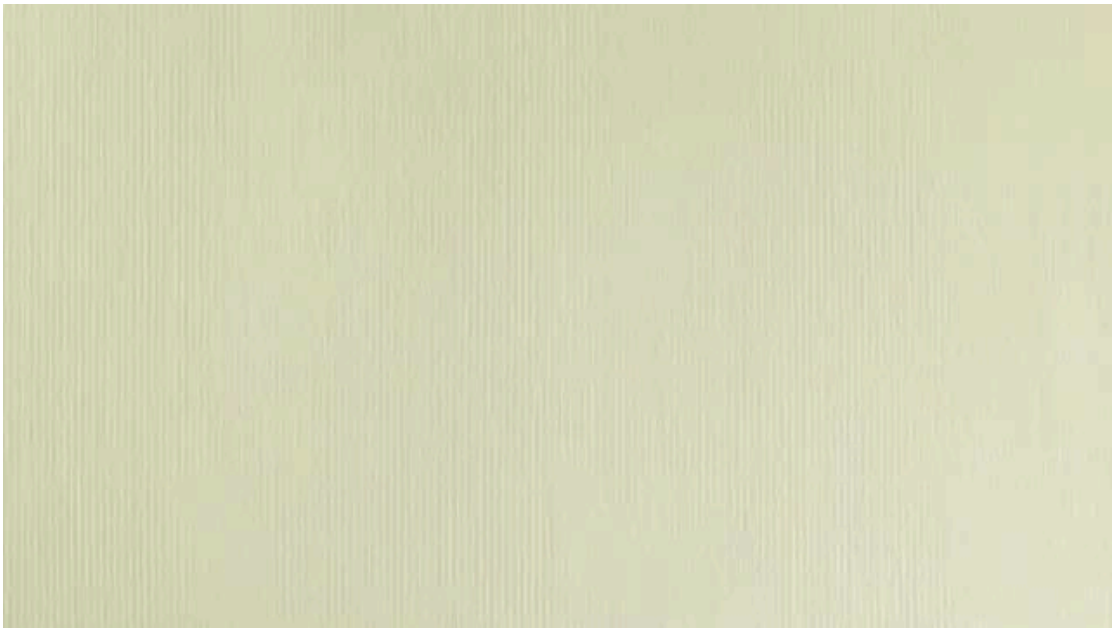
Examples of Student Projects



Examples of Student Projects



Examples of Student Projects



Serpente Rosso