Design Thinking meets Computational Thinking:
Kinetic Art and Embedded Systems
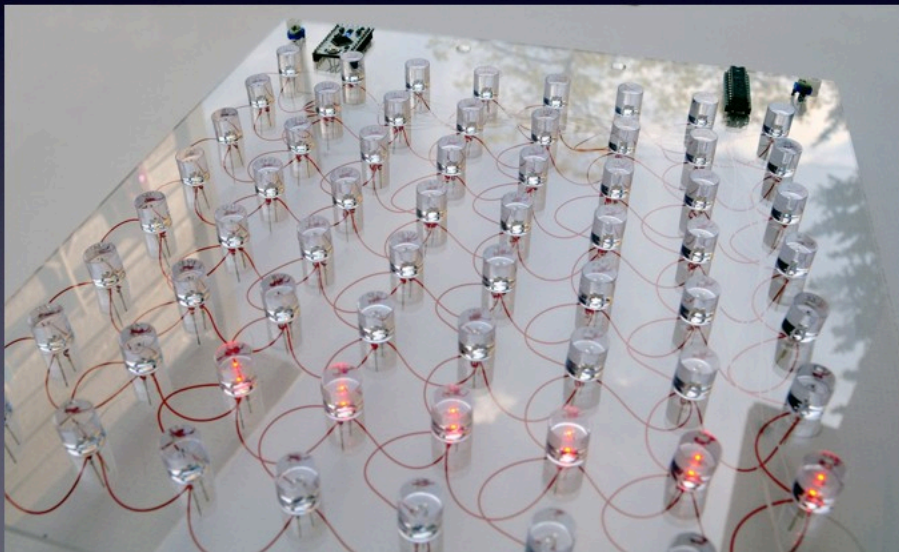
Erik Brunvand
School of Computing
University of Utah
Salt Lake City, UT USA
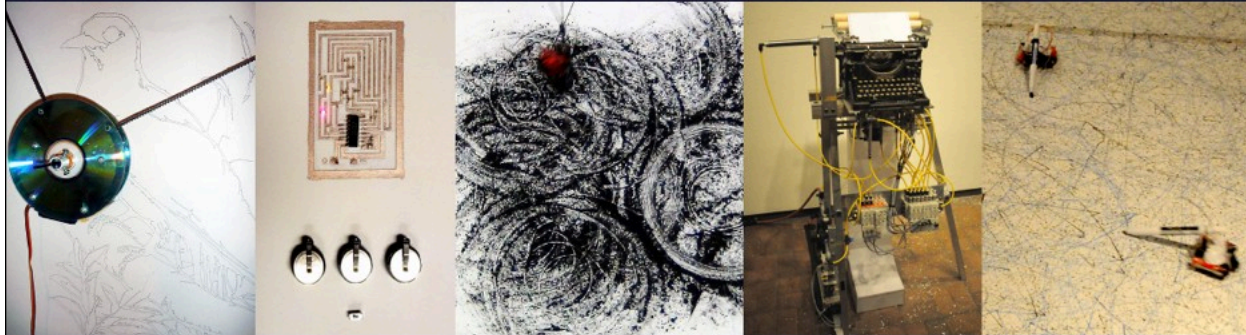
THE UNIVERSITY OF UTAH

Agenda

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

Context

I frame this 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

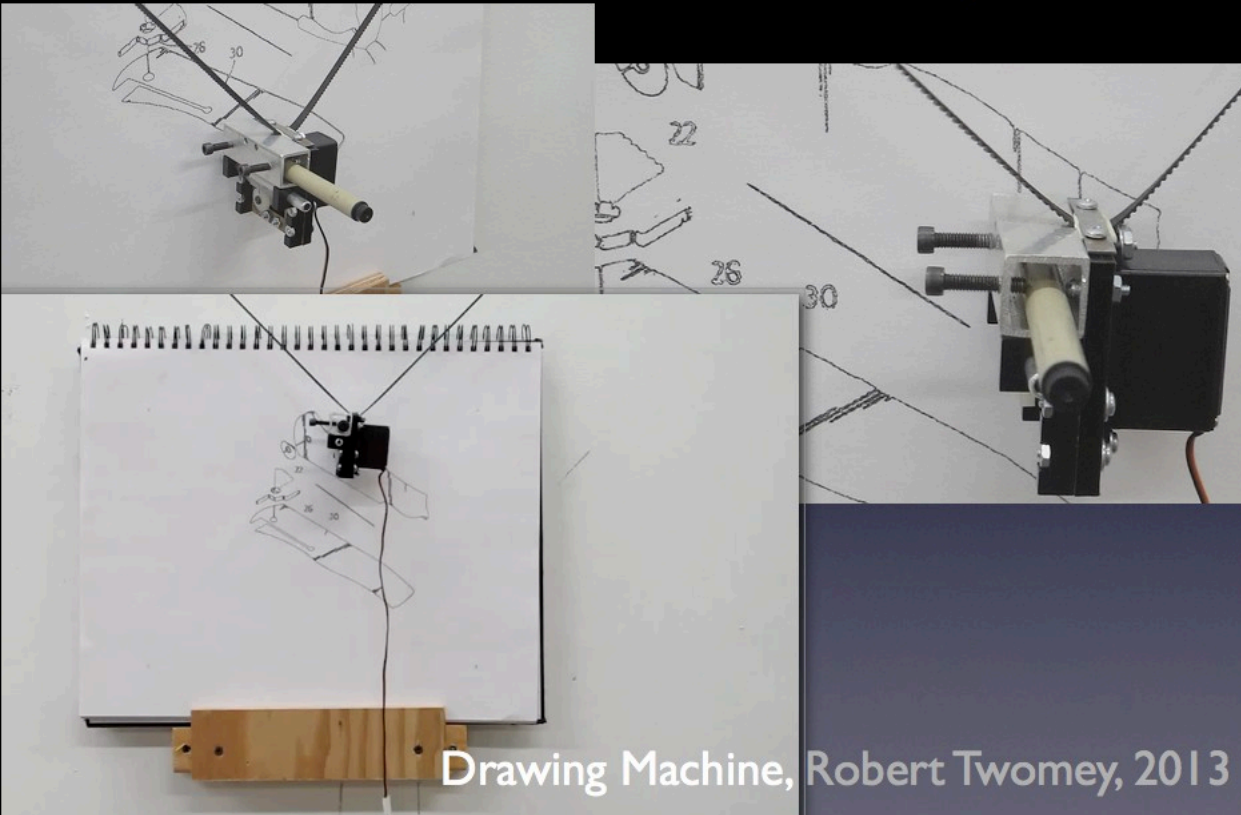 - Often designed to directly control output devices
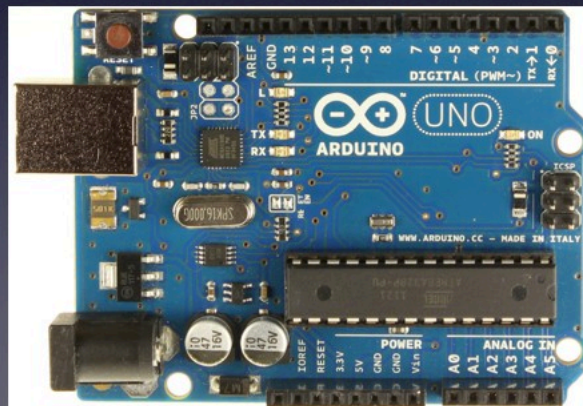
Kinetic Art

- Contains moving parts
  - Depends on motion, sound, or light
- Often controlled by microcontrollers
  - Motors, actuators, transducers...
- Often reactive to environment
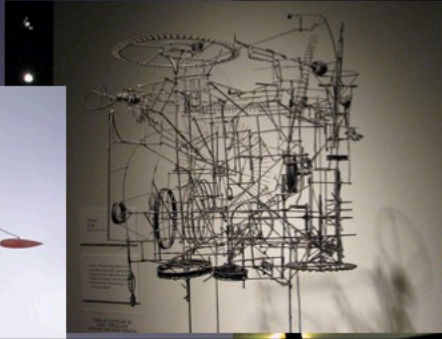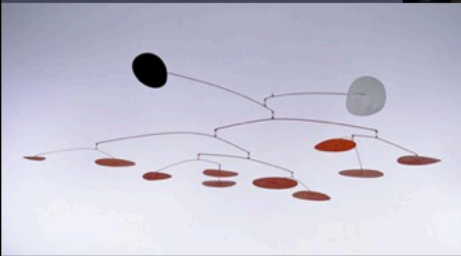
SIGGRAPH Art Gallery

Drawing Machine, Robert Twomey, 2013

CHI Interactivity

Gravity of Light
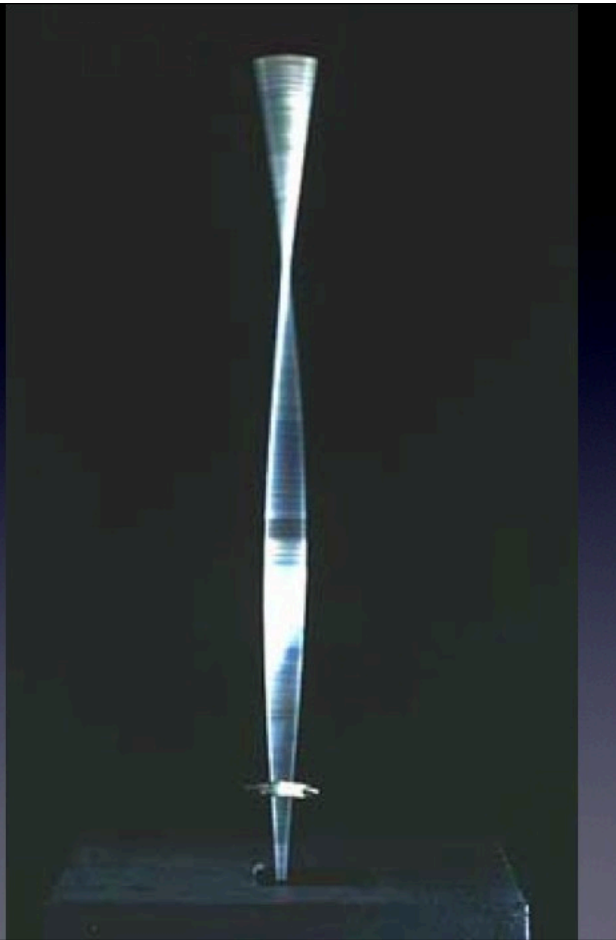3D Printed Wearable Project

YOUNGHUI KIM / YEJIN CHO

Background

- Short survey of kinetic art

  - The avant garde in the 1920's

  - Small steps in the 1950's

  - The computer age

- Outline for a collaborative class
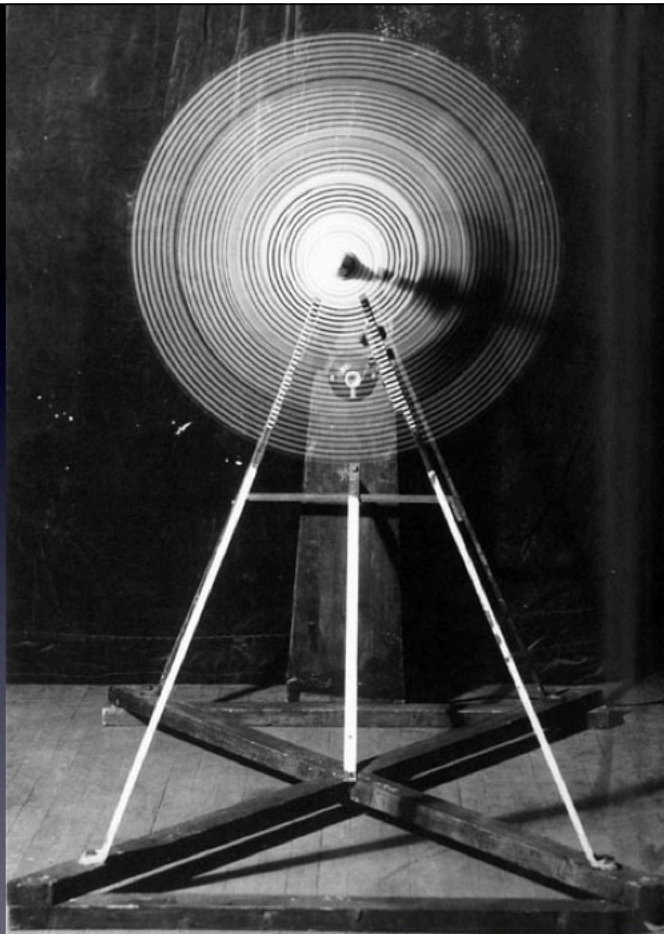
- Examples

Naum Gabo
(1890-1977)

- Kinetic Construction (Standing Wave) 1919-1920

Marcel Duchamp
(1887 – 1968)

- Rotary Glass Plates (Precision Optics) 1920
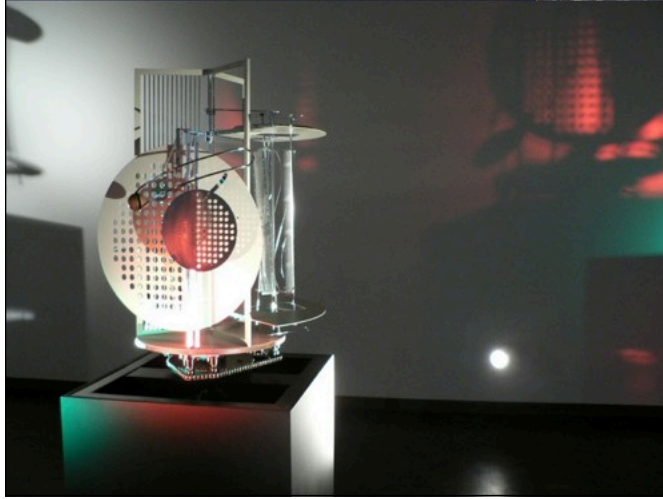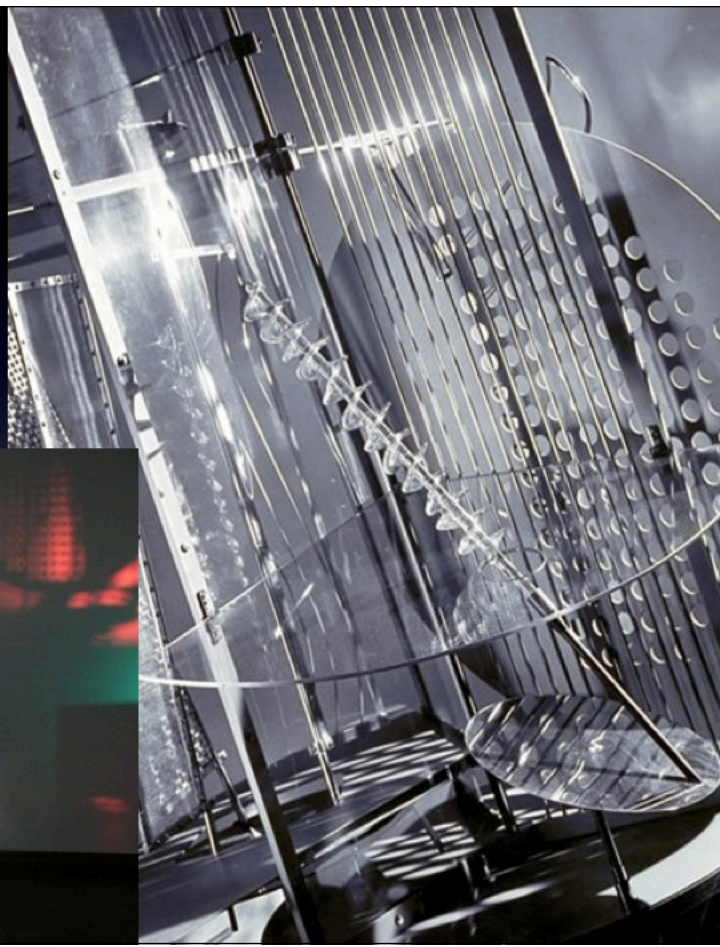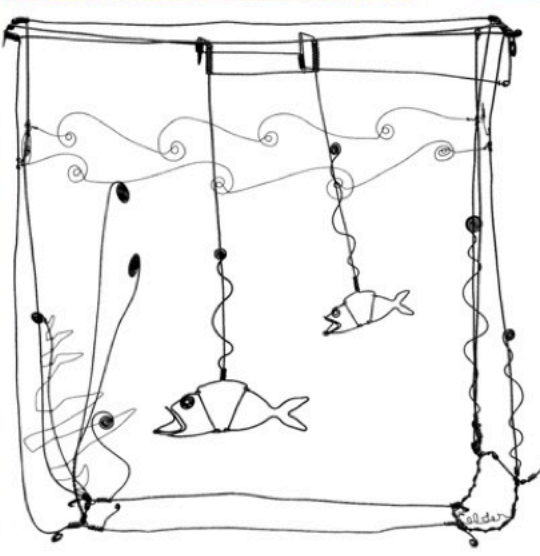
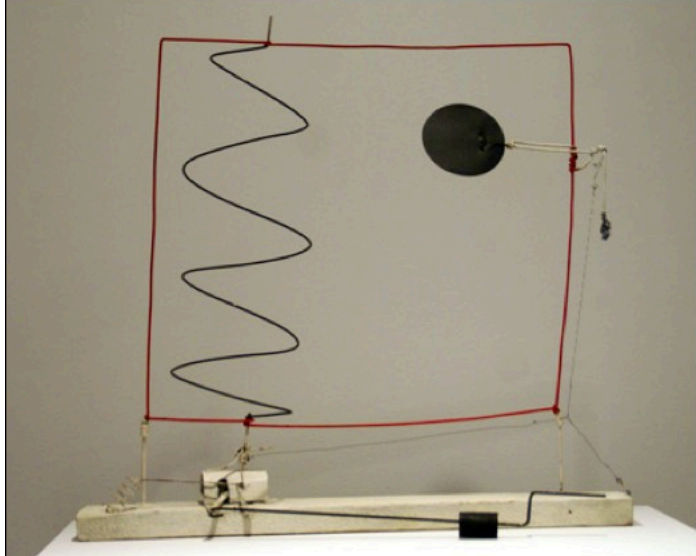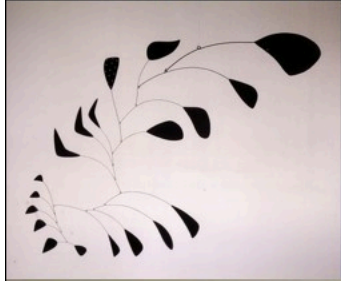- Built with the help of Man Ray
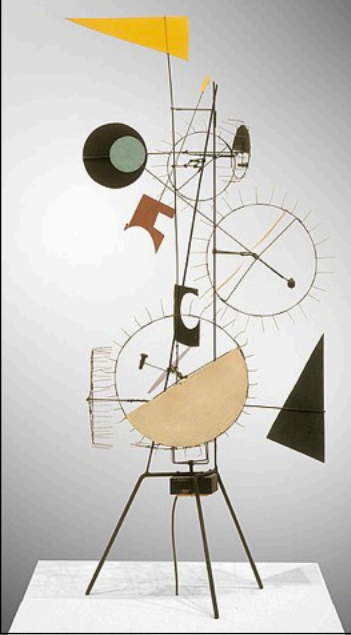
László Moholy-Nagy

(1895-1946)

- Light-Space Modulator (1922-30)

Alexander Calder

(1898 – 1976)

Mobiles and Stabiles
Wire and Circuses

Jean Tinguely
(1925 – 1991)
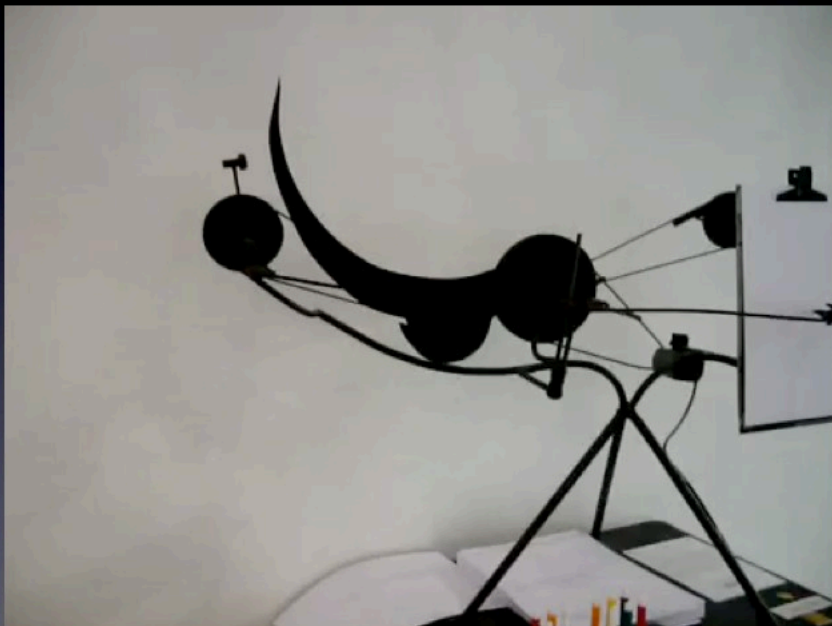
Jump ahead to the Computer Age

- 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.

Jim Campbell's Algorithm
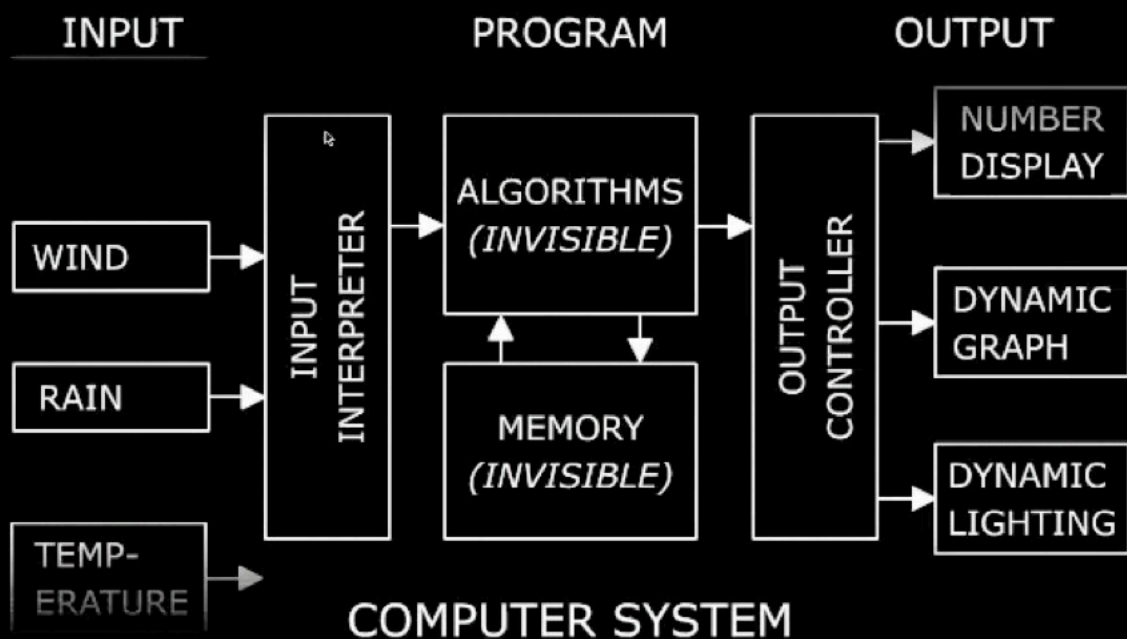
Jim Campbell (1956 -)
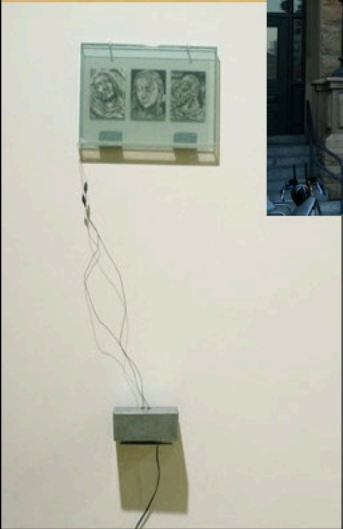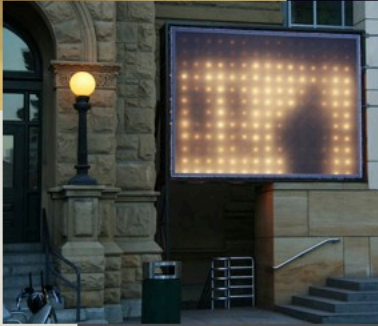
Alan Rath (1959 -)

Daniel Rozin (1961 -)

Arthur Ganson (1955 -)

David Bowen

University of Minnesota, Duluth

David Bowen

Tele-present wind

telepresent wind
2009

Lots of others…

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

Paul Stout

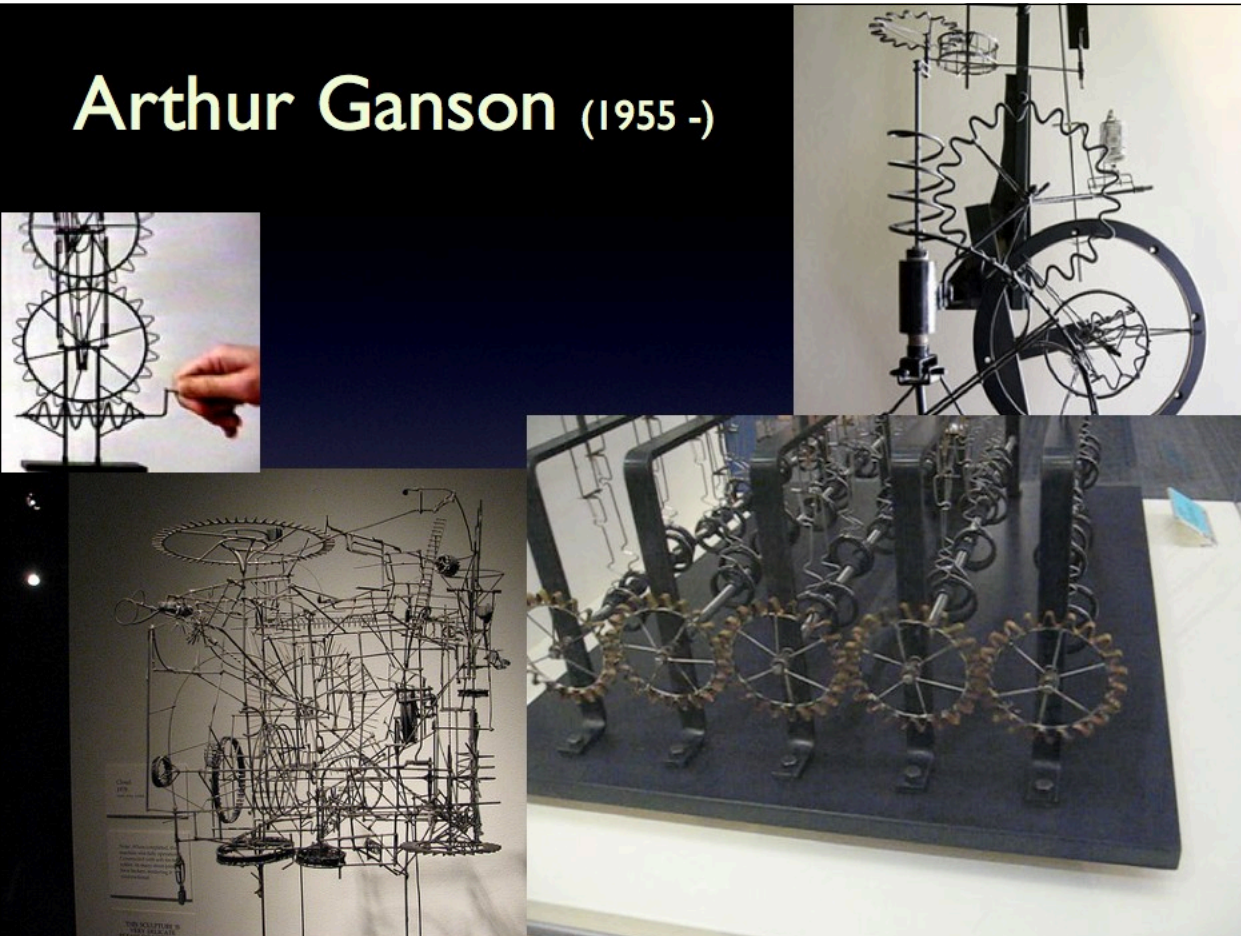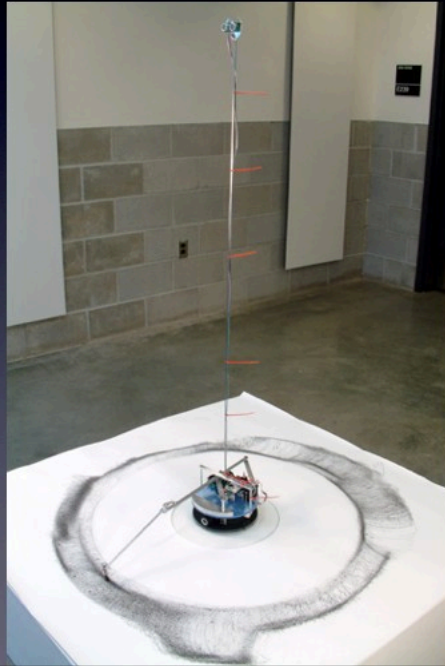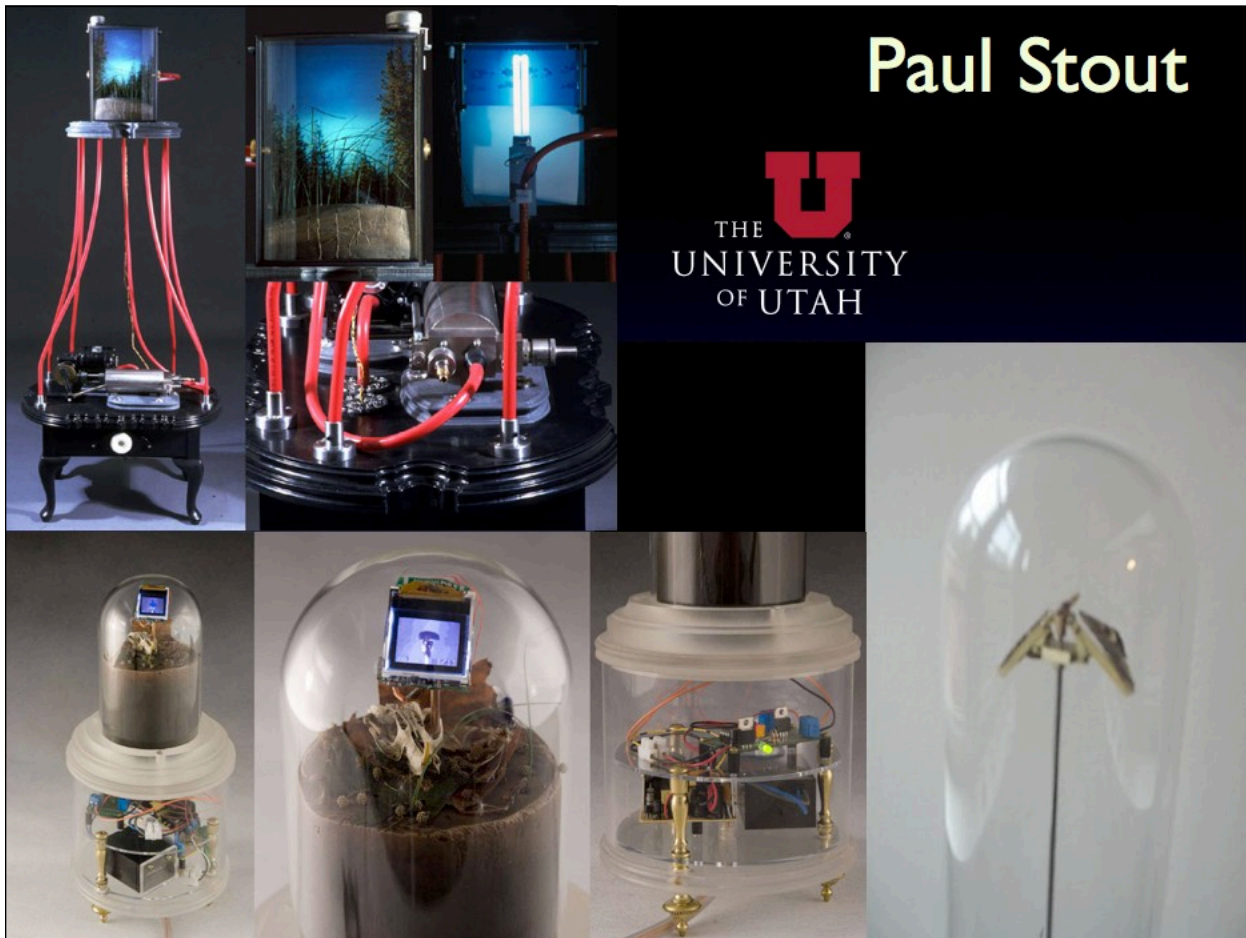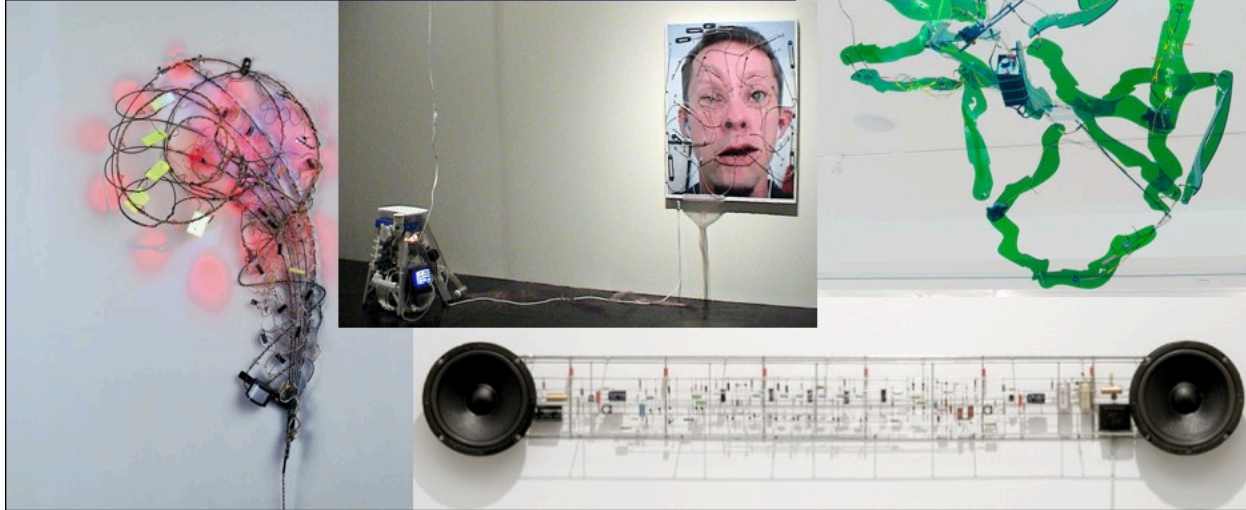# Cross-Disciplinary Class

- 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
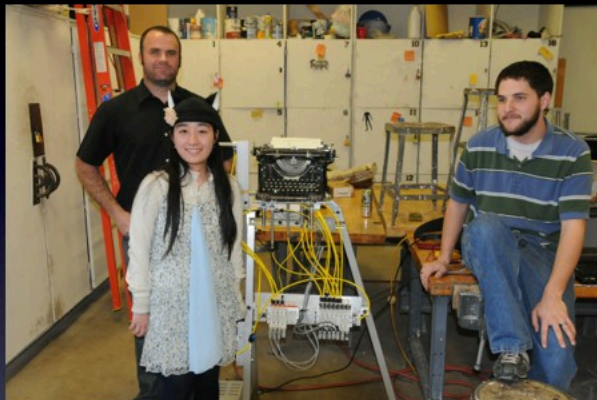
Class Overview

- 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
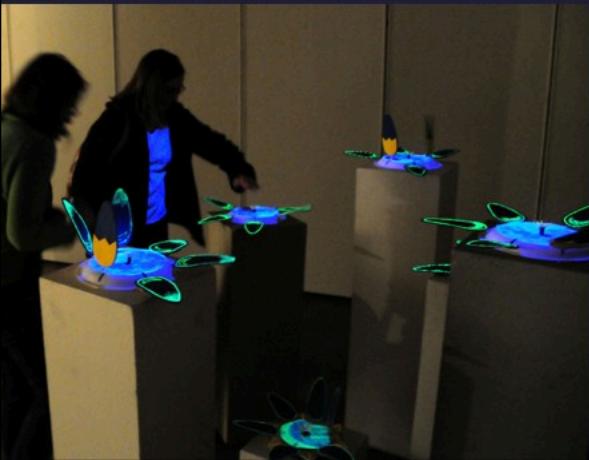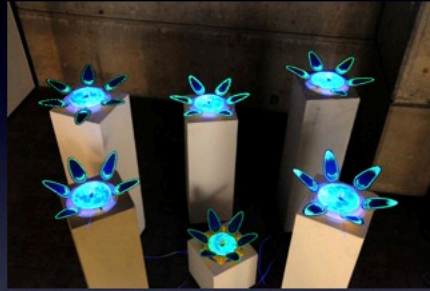
  - Spring 2012: Drawing Machines

# 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

- Controller – Arduino

- 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.
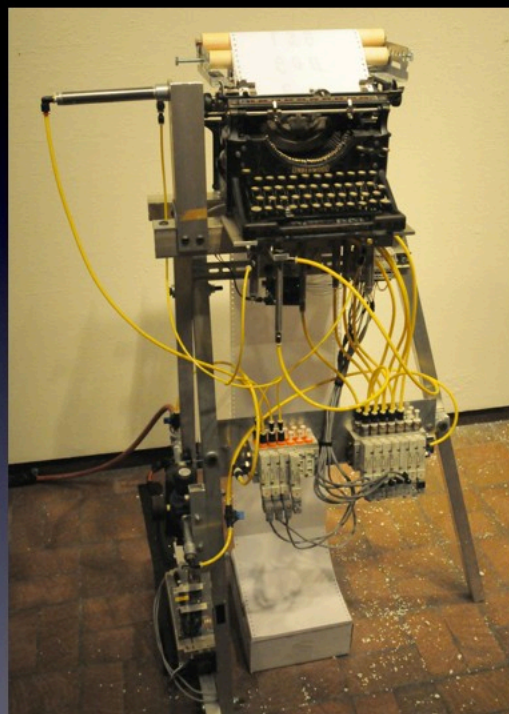
Examples of Student Projects

Examples of Student Projects

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Examples of Student Projects

Student Comments

- I now have a much better understanding of how to "think about art" and also saw an entirely different side of computer science.

    - Artists have a completely different mindset and it was nice to get a new perspective on things. It really made me learn to appreciate the creative thinking they brought to the table.

- I enjoyed it and already have suggested it to several artists and engineers I know!

    - I feel more competent in both [art and computer science] having experienced each side in a new way.

Conclusions

- Embedded systems and kinetic art is a natural collaboration

    - Exploration of fundamental design concepts

    - Design-thinking is a natural complement to computational-thinking

- Studio instruction model is fascinating

    - Both groups of students benefit from working with each other

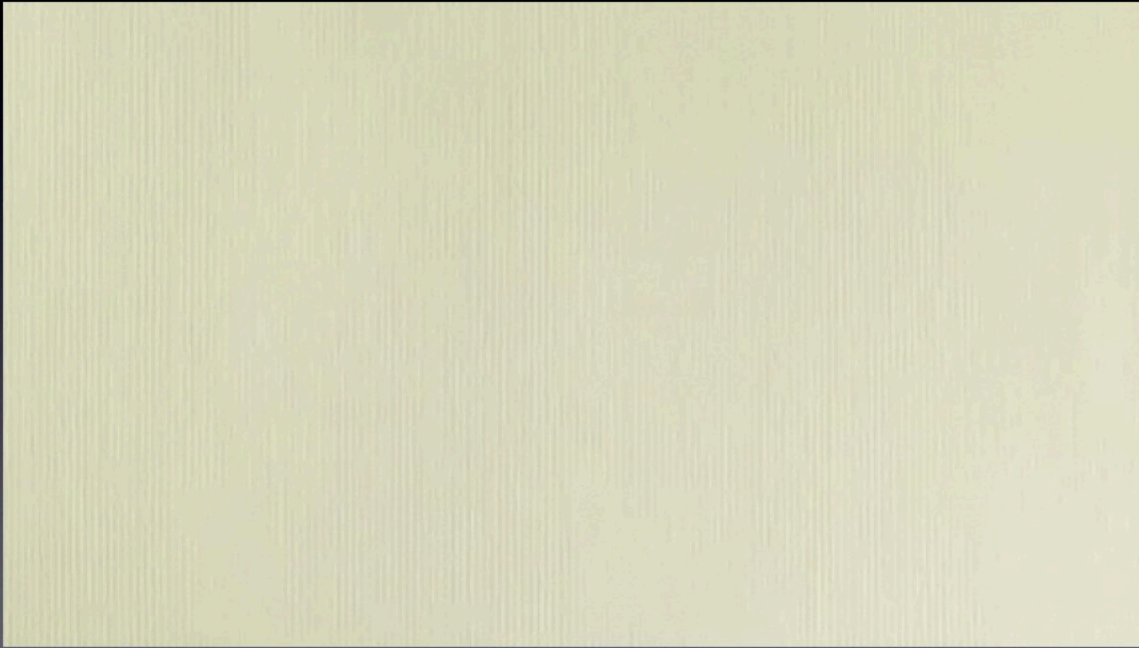   - Cross-college collaboration – just the beginning!

Contact

- Erik Brunvand, School of Computing
  - elb@cs.utah.edu

- Paul Stout, Dept. of Art and Art History
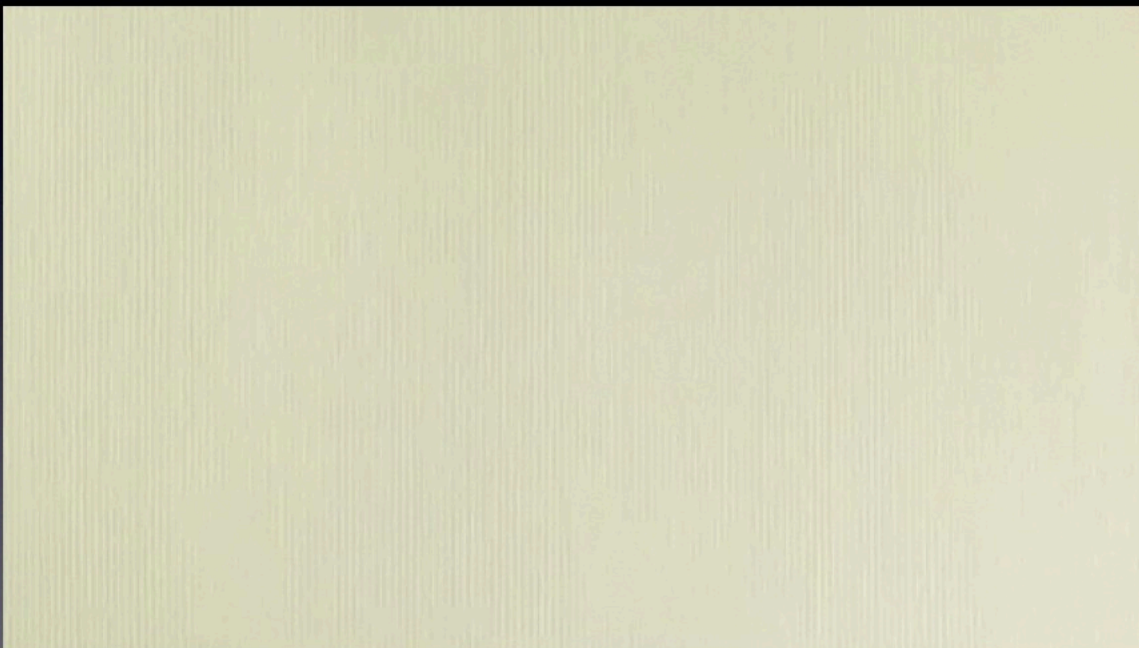 - Paul.Stout@gmail.com

- www.eng.utah.edu/~cs5789

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Extra Slides

- More examples of student projects

Examples of Student Projects
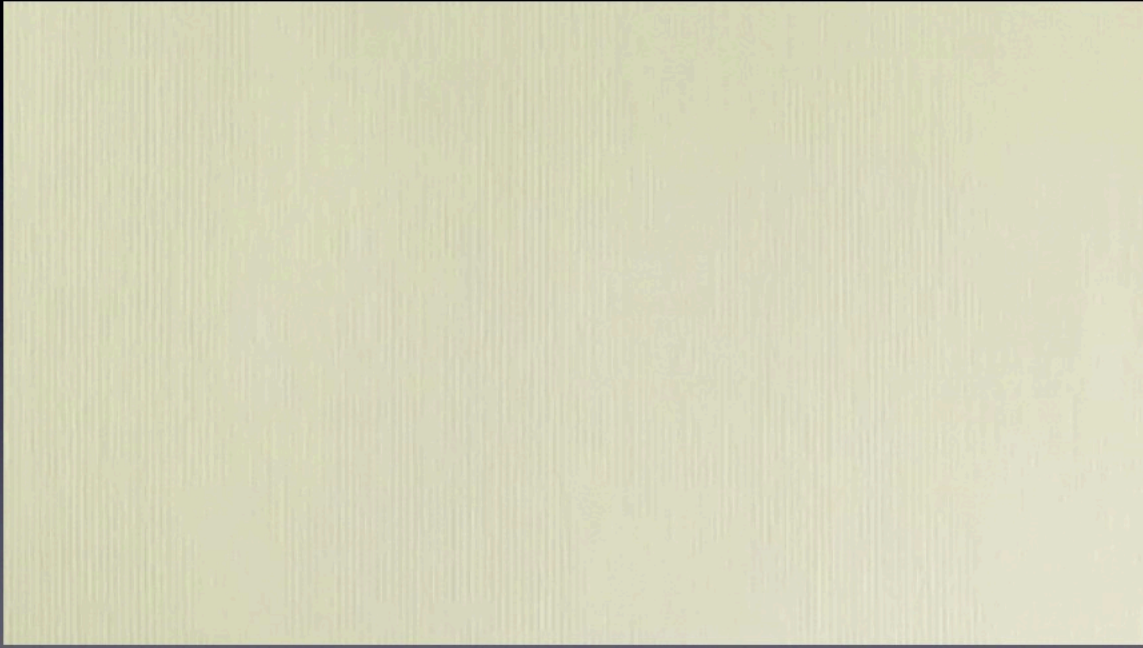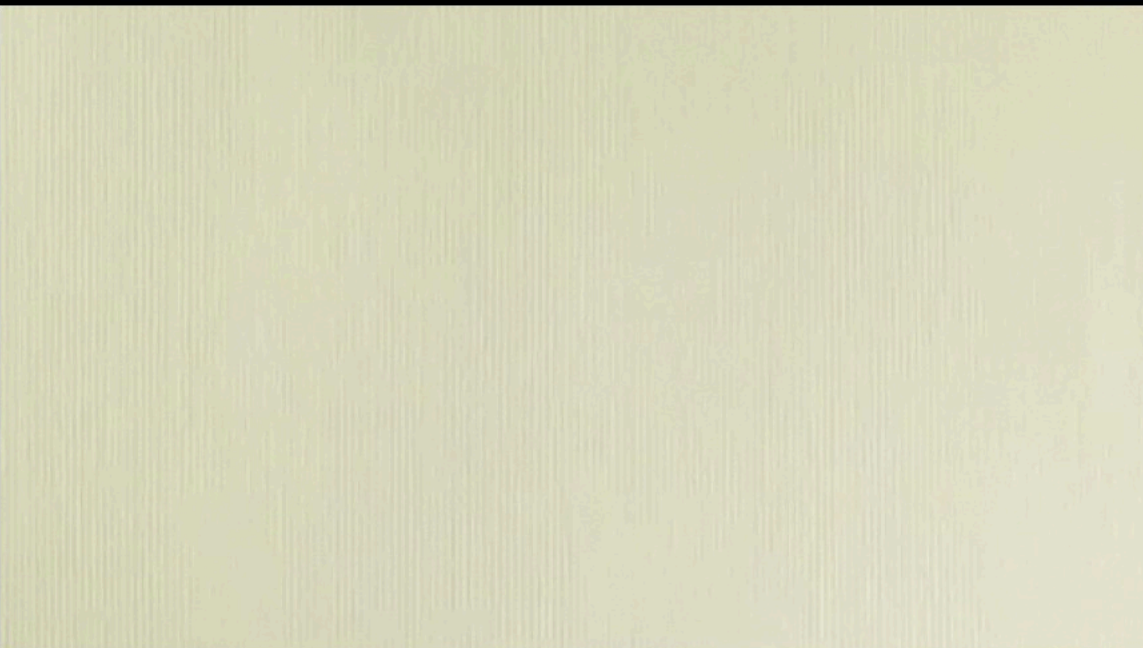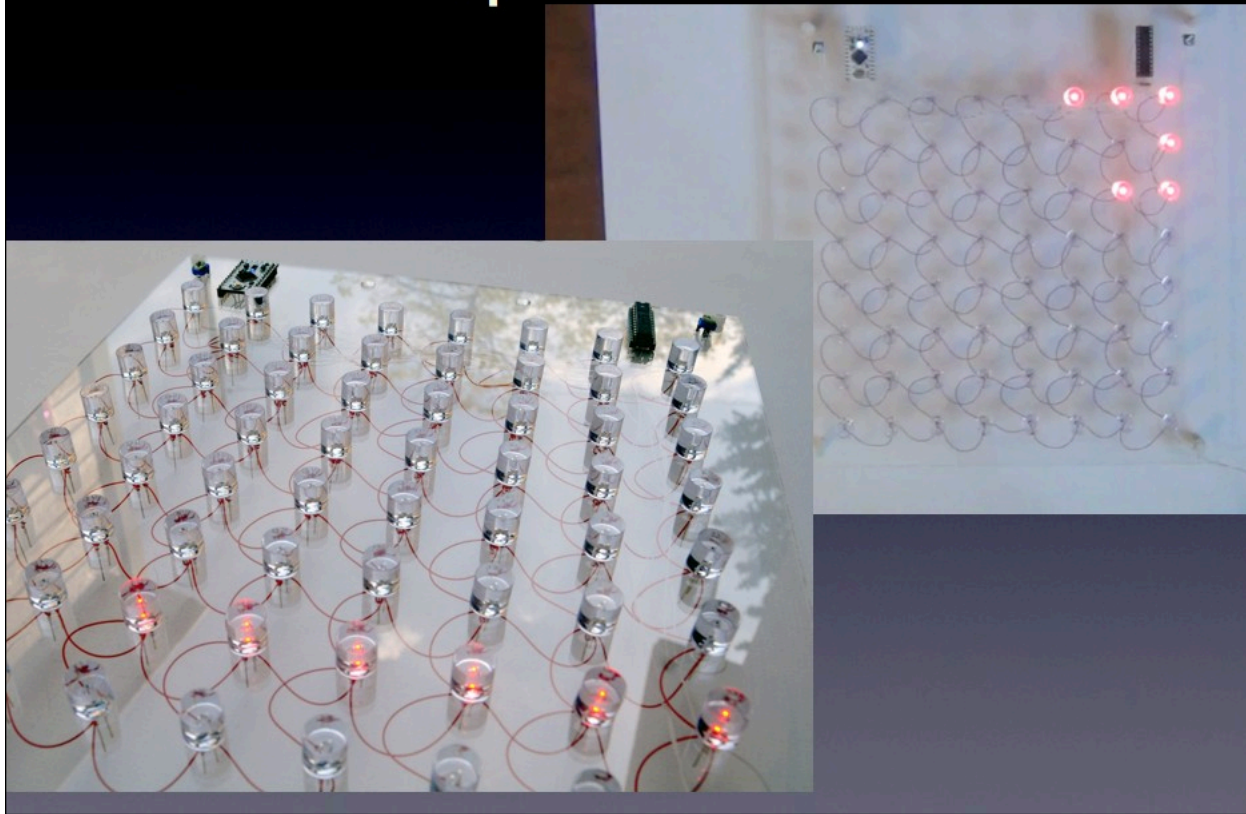
Examples of Student Projects

Serpente Rosso

Examples of Student Projects

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