Design Thinking meets Computational Thinking: Kinetic Art and Embedded Systems

Erik Brunvand
School of Computing
University of Utah
Salt Lake City, UT USA
I argue that arts/technology collaboration is a powerful framework for enhancing ideas in both arenas.
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
Marcel Duchamp  
(1887 – 1968)

- Rotary Glass Plates  
  (Precision Optics)  
  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)
László Moholy-Nagy (1895-1946)

- Light-Space Modulator (1922-30)
Alexander Calder
(1898 – 1976)

Mobiles and Stabiles
Wire and Circuses
Jean Tinguely (1925 – 1991)
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

INPUT

WIND
RAIN
TEMPERATURE

PROGRAM

ALGORITHMS (INVISIBLE)
MEMORY (INVISIBLE)

OUTPUT

OUTPUT CONTROLLER

NUMBER DISPLAY
DYNAMIC GRAPH
DYNAMIC LIGHTING

COMPUTER SYSTEM
Serpente Rosso
Alan Rath (1959 - )
Alan Rath (1959 - )

Art Basel, 2013
Alain Le Boucher
Art Basel, 2013
Alain Le Boucher

Unstable Harmonies

2012
Peter Vogel (b 1954)
Peter Vogel  (b 1954)

Soundwall Performance II
Leo Villareal  (b1967)
Leo Villareal  (b. 1967)
Jenny Holzer (b. 1950)
David Bowen

Tele-present wind

telepresent wind

2009
Rebecca Horn
Hektor - painting device
Lots of others…

Sabrina Raaf, Ann Hamilton, Meridith Pingree, Roxy Paine, Tim Hawkinson, Krzysztof Wodiczko, etc…
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: CS5789

- 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
  • Spring 2014: Input/Artput
  • Spring 2015: C:\Art\Run
Intersectio
Examples of Student Projects
Examples of Student Projects
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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
  - www.cs.utah.edu/~elb
  - www.eng.utah.edu/~cs5789