Design Thinking meets Computational Thinking: Kinetic Art and Embedded Systems

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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
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 Stables
- 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

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INPUT
  WIND
  RAIN
  TEMPERATURE

PROGRAM
  INPUT INTERPRETER
  ALGORITHMS (INVISIBLE)
  MEMORY (INVISIBLE)

OUTPUT
  NUMBER DISPLAY
  DYNAMIC GRAPH
  DYNAMIC LIGHTING

COMPUTER SYSTEM
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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

The University of Utah
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
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

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Extra Slides

- More examples of student projects
Serpente Rosso

Examples of Student Projects
Examples of Student Projects

Examples of Student Projects
Examples of Student Projects

Examples of Student Projects