Embedded Systems and Kinetic Art

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Logistics

- Class meets M-W from 11:50-2:50
- We’ll start meeting in Sculpt 183
  - At some point we may also meet in MEB 3133 (Merrill Engineering Building) on the north side of campus
- Web page is www.eng.utah.edu/~cs5968
- TA is Josef Spjut
  - from School of Computing

Kinetic Art

- Art that contains moving parts or depends on motion, sound, or light for its effect.
  - The kinetic aspect is often regulated using microcontrollers connected to motors, actuators, transducers, and sensors that enable the sculpture to move and react to its environment.

Embedded Systems

- A special-purpose computer system (microcontroller) designed to perform one or a few dedicated functions, often reacting to environmental sensors.
  - It is embedded into a complete device including hardware and mechanical parts rather than being a separate computer system.

Jim Campbell’s Algorithm
This Class

- Enabling engineers and artists to collaborate and make some interesting kinetic art
  - Artists and engineers to work in interdisciplinary teams
  - This will be a cross between an engineering class (embedded system design and programming) and an art studio class (designing and building the sculptures) with all students participating fully in both areas.

How will it Work?

- Good question! It’s an ongoing experiment from both sides...
  - Start with some background study
  - Some hands-on labs with the microcontroller
    - Build a toolkit of input sensors, output transducers and computer code to interface with them
  - Teams will eventually design a project together
  - Class critiques, refinement, final build
  - Exhibit of the results in Spring

Jim Campbell’s Algorithm

Output Transducers

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

Input Sensors

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

- Kinetic concept in a well-conceived and constructed artifact
  - Traditional 3d materials
  - Wood, metal, plastic, wiring, and other structural materials
  - Unattended functioning (i.e. in gallery)
  - Consider maintenance and support issues too...

Microcontroller

- The “brains” that coordinates the kinetics
  - Small computers
  - Typically with special support for sensors and actuators
    - Analog-digital converters on inputs
    - Pulse-width modulation on outputs
- We’ll use one called Arduino

Arduino Community

- Open source physical computing platform
  - "open source" hardware
  - Open source software environment
  - Physical computing means sensing and controlling the physical world
- Community
  - Examples wiki (the “playground”)
  - Forums with helpful people

What is Arduino?

The word “Arduino” can mean 3 things

- A physical piece of hardware
- A programming environment
- A community & philosophy

Arduino Hardware

- Similar to Basic Stamp (if you know of it)
  - But cheaper, faster, & open
- Uses AVR ATmega328p microcontroller chip
  - Chip was designed to be used with C language
Based on the AVR ATmega328p chip
- 8 bit microcontroller (RISC architecture)
- 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

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
UART
SPI/TWI serial interfaces
Programming 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 Arduino environment has lots of nice features to make programming less scary...

Resources for this class

- We have some supplies for the class
  - Arduino boards
  - 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...
  - We can use the electronics lab in the School of Computing, and wood and metal shop facilities in Art

More Arduino Info?

- [www.arduino.cc/](http://www.arduino.cc/)
  - Main Arduino project web site
- [www.arduino.cc/playground/Main/HomePage](http://www.arduino.cc/playground/Main/HomePage)
  - “playground” wiki with lots of users and examples
- [www.freeduino.org/](http://www.freeduino.org/)
  - “The world famous index of Arduino and Freeduino knowledge”
- [www.eng.utah.edu/~cs5968](http://www.eng.utah.edu/~cs5968)
  - our class web site

Wednesday

- We’ll do a hand’s-on session with the Arduino boards
  - Bring a laptop if you have one
  - We’ll write some very simple programs
  - Interface to some very simple sensors/LEDs
- Meet in Merrill Engineering Building
  - Room MEB 3133
Where?

MEB 3133 (DSL)

• Third Floor
• Main NS hallway on the West side of building
• Look for candy machines and metal stairs
• East into hallway
• Recessed door to 3133

Questions?