Introduction to Electronics and Physical Computing for the Arts
Course Number: DANM 133
Instructor: Daniel Christopher
Summer 2012 Syllabus

THIS SYLLABUS IS SUBJECT TO CHANGE AT INSTRUCTOR'S DISCRETION

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Office Hours: by appointment

Course Description:
Introduction to Electronics and Physical Computing for the Arts is both an introduction to building electronic artwork using the open-source Arduino platform, as well as an examination of this technology's role in contemporary digital art. Through hands-on tutorials, students will experiment with building electronic circuits and coding in the Arduino programming environment to create an interactive art project that illustrates key principles learned in the course. Students will be introduced to components such as sensors, switches, motors, and lights, as well as technical principals such as electricity, circuits, soldering, and the use of testing equipment in a workshop setting. In addition to building circuits, we will explore how artists use these devices to gather data and produce a variety of output through presentation and analysis of digital artworks.

Course Requirements:
Class Attendance/Participation (20% of final grade)
Attendance and class participation are required. Three unexcused absences will result in failure of the course. Be sure to inform the instructor **in advance** if you know you will be unable to attend one of these sessions for medical reasons, due to religious holiday observance, etc.

Weekly Assignments (30% of final grade)
There will be weekly assignments integral to a practical understanding of the material. Students are expected to complete the assignments and submit them at the beginning of the following session.

Final Project (project 20%, paper 20% of final grade) & **Presentation** (10% of final grade)
The course will culminate with student final projects and presentations. The criterion for the final project is an interactive circuit that collects data and produces an output. The project will be supported by a three to five page paper discussing the technical information and creative motivations behind the work, as well as a 5-minute demo and presentation.

Course Policies:
Students are required to do reading **prior** to class on the day scheduled and are expected to research and become familiar with digital artworks for weekly discussions.

Required Reading:
- Paul, Christiane (2008). *World of Art: Digital Art*. (2nd Edition).
- Wilson, Stephen (2010). *Art + Science Now*.
- Scherz, Paul. (2007) *Practical Electronics for Inventors*. (2nd Edition).
- Amdahl, Kenn (1991) *There Are No Electrons: Electronics For Earthlings.*
- Mims III, Forest M. (1983). *Getting Started in Electronics*. (12th edition).
- Banzi, Massimo. (2008). *Getting Started with Arduino.* O' Reilly Media.

*All sources are available either online or on reserve at McHenry Library

Week 1: Arduino, Electricity, and Components

Session 1 Introduction to the syllabus, schedule, course material, and to each other. Students will become familiar with the concept of physical computing through basic Arduino sketches - delving into the integrated-development environment (IDE) by building a circuit with an LED and push buttons Discussion of Arduino's role in a variety of digital art & new media projects. Brief history of DANM and tour of DARC.

Assignment #1: Expand on the Arduino sketch built in class by adding 5 LEDs.

Session 2 Presentation of DC electronics and principles, including Ohms law, interpreting schematics, batteries, breadboards & PCB, wire, connectors, and switches. We will cover the functions of these electronic components, and the process of making circuits. After constructing a circuit, the class will dig deeper into Arduino programming. Discussion of digital art's origins and presentation of works by early practitioners.

Due: Arduino LED circuit & sketch

Reading: Mims p. 6-14, Banzi p. 1-7, Paul p. 8-27

Assignment #2 & 3:
(1) Build 10 oomlout Arduino sketches involving LEDS, servos, buttons, and a piezo buzzer. Modify one Arduino sketch (by hacking the code), and build a circuit with your Arduino.
(2) Write a one page response to the Introduction of *Digital Art.*

Review & Discuss:
Nam June Paik: *Random Access* (1963)
Billy Kluever's Experiments in Art and Technology (1966)
LACMA Art & Technology Show (1969-1970)
Newton Harrison: *Aurora Borealis* (1970)
Rockney Krebs: *Day Passage* (1971)

Web Resources:
Arduino Introduction: http://arduino.cc/en/Tutorial/HomePage
Oomlout Sketches: http://oomlout.com/a/products/ardx/
Electronics Primer: http://www.kpsec.freeuk.com/study.htm
Sparkfun Tutorials: http://www.sparkfun.com/tutorials

Week 2: Programming, Soldering, and Tools

Session 3 Fundamentals of programming for Arduino: code structure, syntax, variable types, declarations, time, logical comparisons, loops, serial communication, and math operations. Review of the Arduino data sheet and digital & analog pins (types of data input/output). Students with programming experience will work on serial communication between two Arduinos.

Due:
(1) 10 Arduino sketches, one Arduino circuit, & write up on digital artwork
(2) One page response to Introduction of *Digital Art*

Reading: Scherz p. 5-17, Amdahl, Chapter 1

Assignment #4 & 5:
(1) Complete one original Arduino sketch and circuit
(2) Research a digital art project and write a two paragraph description explaining how it works.

Session 4 Soldering workshop: students will learn how to safely use tools such as a soldering gun, helping hands, and multi-meter, by practicing soldering wire to basic components and a PCB board. After assembly, students will test the continuity of their circuits with a multimeter and power boards with a bench supply. In class assignment: make a solder cube. Programming review from last section.

Due:
(1) One original Arduino sketch and circuit
(2) Write up on digital artwork

Reading: Mims p. 19-37, 44-51 Banzi p. 29-51 [Chapter 4], Paul p. 204-212

Assignment #6 & 7:
(1) Transfer original Arduino circuit to PCB protoboard
(2) Write a two page response to the *Digital Art* reading, one page explaining an artwork mentioned and how it fits into the movement, and additional page of a conceptual artwork in the style of tactical media & activism.

Review & Discuss:
Wifaa Billal, *Shoot an Iraqi* (2000)
Cory Arcangel, *Super Mario Clouds* (2002)
Improve Everywhere, *Central Grand Freeze* (2008)
Jesse Fulton, *@Barak Obama Hears You* (2009)
James Clar: *Border Patrol* (2011)

Web Resources:
Arduino Programming Reference: http://arduino.cc/en/References
Adafruit: http://adafruit.com/
Jameco (Parts): http://www.jameco.com
Phidgets: http://www.phidgets.com/
Trossen Robotics: http://www.trossenrobotics.com/

Week 3: Advanced Components and Project Development

Session 5 Presentation of new components: servos, motors, solenoids, capacitors, transistors, relays, IR distance sensors, and digitally-addressable RGB LEDs. Workshop on reading schematics and decoding data sheets for these components. Students will also have the opportunity to make their own custom PCB board, and/or assemble an Arduino from scratch.

Due:
(1) Arduino circuit on PCB board
(2) Two-page response

Reading: Scherz p. 18-28, Amdahl, Chapter 2, Paul p.63-87

Assignment #7 & 8:
(1) Incorporate one or more of the newly presented components into an original Arduino sketch.
(2) Prepare presentation: one digital artwork, and idea for final project.

Session 6 Brainstorm session for final project. Students will each present one digital artwork researched in the course, and an original idea for a final project. The class will provide feedback and critique. Presentation of digital art projects from festivals such as Nuit Blance, Luminale, and Burning Man.

Due: Original Arduino sketch and circuit with one advanced component.

Reading: Banzi p.53-73, Amdahl, Chapter 3, Paul p.67-83

Assignment #9: Final Project Proposal – one page typed document describing an Arduino-powered project. Please email this before next week.

Review & Discuss:
Jeffrey Shaw: *The Legible City (1990)*
Daniel Rozin: *Wooden Mirror* (1999)
Robert Lazzarini: *Skull*s (2000)
Scott Snibbe: *Blow Up* (2005)
3waylabs: Modular Cubatrons (2009-2011)
Jill Naiman: *LED Hat* (2009)
Sudhu Tewari: *The Minaret* (2010)
Eric Redl: *Shifting, Very Slowly* (1998-9)

Web Resources:
Arduino Playground: http://www.arduino.cc/playground/
Liquidware: http://www.liquidware.com/
Jameco: http://www.jameco.com/
Circuit Board Etching: http://www.jameco.com/Jameco/PressRoom/makeoneetch.html?CID=circuit
Arduino from scratch: http://www.jameco.com/Jameco/workshop/JamecoBuilds/arduinocircuit.html

Week 4: Interactivity and Fabrication

Session 7 Guest speaker: digital artist Jill Naiman, digital artist in the UCSC Astrophysics doctorate program. Workshop for interactive components, including accelerometer, ultrasonic range finder, and pressure sensors. Individual meetings with students on project proposals.

Due: Final Project Proposal

Reading: Banzi p.74-89, Art + Science Chapter 6

Assignment:
(1) Revised Project Proposal
(2) *Optional*: Bring material for laser cutter

Session 8 Fabrication design workshop. Introduction to vectorizing and rasterizing a variety of materials with an Epilog Laser Cutter to make housings and holders for Arduino and components. Discussion of design for installation and “bombproofing.”

Assignment: Work on Final Project, Paper, and Presentation - **due 8/24.**

Review & Discuss:
Douglas Easterly & Matthew Kenyon: *Spore 1.1* (2004)
Golan Levin: *Manual Input Sessions* (2004)
Lyes Belhocine: *Sounds Interesting...* (2010)
Daniel Christopher: *Trigger Pads* (2011)
Dustin Raphael: *Sight...Sound...Touch* (2011)

Web Resources:
LadyAda Tutorials: http://www.adafruit.com/tutorials
MAKE Tutorials: http://makezine.com/arduino/
Cool Neon: http://www.coolneon.com/
Deal Extreme: http://www.dealextreme.com/

Week 5 Workshop and Open Studio

Session 9 Open workshop time. Instructor will help students debug Arduino code and make sure circuits are functional for final presentations.

Session 10 The final class session will consist of student presentations, demonstrations, and a critique.

Due: Final Project, Paper, and Presentation