Sensing and Control Systems for Digital Art Au13

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DXARTS 470: Sensing and Control Systems for Digital Art, Autumn 2013

MW 9:30-11:20 Fremont Studio (directions)

SCHEDULE

Sensing and Control Schedule Autumn 2013

DESCRIPTION

DXARTS 470 is a studio course focused on the development of innovative processes and techniques for real-time I/O, communication and control within the context of contemporary experimental art practice. The course covers real-time systems programming and basic digital / analog electronics, and looks to locate these techniques within a wider aesthetic framework and historical tradition. In building a critical language with which to analyse relationships between real and virtual, static and mobile, local and remote, online and offline, students are encouraged to implement new tools, new systems and new presentational scenarios for performance, art installations, and other digital arts applications.

An intensive ten-week course, we will cover basic techniques early-on and reinforce them through extensive hands-on work, availing ourselves of pre-packaged hardware, software, and rapid-prototyping tools.

DETAILS

Instructor - Robert Twomey (rtwomey@uw.edu).

Office Hours - MW 11:30-12:20

Teaching Assistant - Shih-Wei Lo (swlcomp@uw.edu)

Office Hours -

Email List - dxarts470a_au13@uw.edu

Drop Box - https://catalyst.uw.edu/collectit/dropbox/rtwomey/29021

LAB KIT

Sensing and Control Parts List

We have purchased most of these parts for in class use. You will need to return them at the end of the term. I would suggest that you purchase an arduino and any of the sensors, tools, etc., for personal use if you intend to continue with this sort of work.

Alternate suppliers exist for many of these parts (Adafruit, Sparkfun, Digikey, and others all stock common Arduino things), check with us if you are ordering from a different supplier.

STUDENT RESPONSIBILITIES AND REQUIREMENTS

- Attend all lectures, workshops, labs and critiques (class is Monday, Tuesday, Wednesday, and Thursday each week).
- The class has nineteen sessions over 5 weeks, so each will have a lot of information packed into it. It is important that you don't miss any sessions and attend regularly. If you have to miss class due to emergency, illness or due to an established religious holiday, then you must notify the instructor directly and in advance. You will be expected to make up any missed sessions.
- Students are expected to come to class on time, ready to start promptly. Please bring any required materials, homework and notetaking equipment.
- Complete lab exercises and/or reading homework, typically small experiments related to the current week's topics.
- Participate in class discussions.

- Complete three weekend projects: late work will not be accepted.
- Complete a final project and presentation: late work will not be accepted.
- Creative experimentation is required and expected: attempt the impossible; use your imagination to stretch the boundaries of any and all assignments.

PROJECTS

You will do a small project each weekend between Wednesday class and Monday morning. These prompts will incorporate material learned during the week. We will have abbreviated discussions of these works on Monday mornings. They will be graded on completion rather than given a point value. Together, the prompt responses will account for 50% of your grade.

The Mid-Term and Final project account for the other 50% of your grade.

- **Mid-Term Project: An artwork where invisible parts share equal importance with visible parts.**
- **Final Project: open assignment.**

To receive credit for each project, you will need to turn in visual documentation (minimum of three photos/videos) as appropriate, schematic diagrams, and source code for arduino, processing, and any other technologies you are using. These will be turned in to Drop Box in catalyst web-tools.

GRADING

Grading of all assignments will be based upon the quality of concept, experimentation, work ethic and realization.

The overall class grade will be broken down between weekly projects and a final project:

Weekly Assignments: 50% (completion only)

Midterm Project: 20%

Final Project: 30%

POLICIES

No smoking, eating or drinking in the laboratory, classroom or building. Back up your data. No excuses for losing papers, web documents, images, etc. Keep at least three copies of everything: one on your hard drive, one on a CD, and one somewhere else just in case. If you have a disability that you think may impact your participation in this class, please contact Disabled Student Services. Every effort will be made to accommodate your needs.

FREMONT LAB POLICIES

Students have access to the DXARTS Sensing and Control Laboratory according to the following lab policies:

- any equipment that you have used must be put away in its proper place before you leave the lab.
- be considerate to other users of the lab. Do not leave any mess behind.
- never use a power tool without someone else being in the lab.
- never use a tool which you have not been trained to use, or which you do not feel comfortable using.
- never use a tool that is damaged. If you discover a tool that is damaged, report it to your TA immediately.
- never work in the lab when you feel tired or drowsy, or under the influence of medication.
- if the lab is unsupervised, only use tools that are you are allowed to use without supervision. If you want to use a tool that requires supervision, then contact your class TA.
- always wear appropriate clothing in the lab. No open-toed sandals, loose clothing, etc.
- do not use power tools whilst wearing gloves.
- tie back long hair while in the lab.
- use goggles and, where appropriate, ear protection when using power tools.
- do not use noxious chemicals in the lab.
- Students will be assigned equipment that must be returned on time.

SHOP ORIENTATION/SAFETY CLASS

This introduction with the shop manager is required to use any tools at the Fremont lab!!

Fremont Resources

PAST COURSES

Sensing and Control - Summer 2013

Sensing and Control - Summer 2012

Sensing and Control - Summer 2011

Sensing and Control: Schedule au13

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(this schedule will be updated as the course progresses)

Week 0

[9/25] :: Introduction and Light Blink

Lecture: Course Introduction

dxarts470_lecture1_intro.pdf

In-class:

- Install arduino software. Download the appropriate version from the arduino website.
- How to Connect and Upload a program. Getting Started with Arduino.
- Basic Arduino programming.
- In class work on Prompt 1.

Homework:

- Prompt1.pdf
- Read catalog for *Software* show, Jewish Museum,1970 (pdf)

Week 1

[9/30] :: Arduino, Digital I/O

Shop Overview

Lecture: Arduino, Digital I/O

dxarts470_lecture2_1_arduino_basics.pdf

dxarts470_lecture2_2_digital_io.pdf

In-class:

- setting up a breadboard, color-coding.
- coding basics (bare minimum)
- led output (resistors, current), **01.Basics-Blink**
- coding (for loop): **05.Control-ForLoopIteration**
- led matrix (dual for loop): **04.Control-RowColumnScanning, 07.Display-BarGraph**
- switch input (logic-level signalling, pull-up/pull-down resistors, active-high/low): **01.Basics-Button, -DigitalReadSerial**
- input debouncing: **02.Digital-Debounce**
- state-change, toggle switch: **02.Digital-StateChangeDetection**

Homework:

- Breadboarding exercises:
  - Build each of the above examples (digital input and digital output) on your breadboard.

- Build a for loop/bar graph.
- Build a toggle switch that has some visible output.

[10/2] :: Day 3 - Digital I/O continued

In-Class

- Continue work on digital input and output. Get at least one example of digital input (active high, active low) and digital output (led and current limiting resistor) working before the end of class.
- Look at other kinds of switches (reed switch, tilt switch, knife switch, pressure pad)
- Look at other kinds of digital outputs (piezo buzzer **02.Digital->toneMelody**)
  - piezo to play melody
- Prompt 2.

Homework:

- Prompt2.pdf, to be discussed at the beginning of on Monday.

Week 2

[10/7] :: Day 4 - Analog Input

Review Prompt 2 Responses

Lecture: Analog Input

dxarts470_lecture3_1_analog_in.pdf

dxarts470_lecture3_2_serial_communication.pdf

In-Class:

- analog inputs on arduino. **01.Basics-AnalogInput**, **03.Analog-AnalogInOutSerial**
- passive (resistive) sensors: (potentiometer, skin conductance, photoresistor, thermistor, flex sensor)
- active sensors (IR range finder, temperature sensor, capacitive touch, knock)
- relaying data to computer (serial monitor, processing, python, sc, firmata)
- **03.Analog-AnalogReadSerial**, **-ReadAnalogVoltage**
- **04.Communication-VirtualColorMixer**
- bar graph (analog input, 10 leds) **07.Display-BarGraph**
- analog in with analog out: **03.Analog-AnalogInOutSerial**

Homework:

- Breadboarding exercises:
  - Work through analog examples:
  - Try various kinds of inputs (potentiometer, photoresistor, flex sensor)
  - Use the serial interface to debug analog values (or control something on the computer)

[10/9] :: Day 5 - In Class Work

In-class:

- Hands-on with analog inputs.
  - Sampling (10bit, 1024)
  - passive (potentiometer, photoresistor, flex sensor, thermister): voltage divider
  - active (IR range finder, temperature sensor)

Homework:

- Read Jack Burnham, *Systems Esthetics,* Artforum 1968
  - burnham_systems_esthetics_1968.pdf (with pictures)
  - sys_aes.pdf (text only)

- Bring an example of an artwork that supports (or challenges) Burnham's ideas, and be prepared to discuss the essay.

Week 3

[10/14] :: Day 6 - Analog Output + Motor Basics

Lecture: Analog Output, Motors

dxarts470_lecture4_analog_out_motors.pdf

In-Class:

- dim an LED:
  - PWM_led.zip
  - PWM_led_pot.zip controlled with a knob
- sweep a servo:
  - **Examples-Servo-Sweep**, using the servo library.
  - **Examples-Servo-Knob**, control a servo position with a potentiometer. feedback?
  - try this with a modified continuous rotation servo.
  - setting position with Servo.writeMicroSeconds()
  - doing it by hand using delays servo_sweep.zip
- control a servo over the serial port from processing:
  - servo_serialout.zip (processing sketch, sends commands)
  - servo_serialin.zip (arduino program, receives commands)
- DC Speed Control: DC_motor.zip
- Directional DC control with H-Bridge: DC_motor_hbridge.zip

[10/16] :: Day 7 - High Current Digital

Lecture: High Current Digital

dxarts470_lecture5_high_current_digital.pdf

In-class:

- Continue analog inputs and outputs.
- Continue work with DC motors, pwm, H-Bridges (yesterday's lecture)
- Relay/Solenoid experiments. (last page of lecture).

Homework:

- Prompt 3: Prompt3_dxarts470_au13.pdf
- Norbert Weiner, *Cybernetics,* 'Chapter 4. Feedback and Oscillation' weiner_chap4_feedback_and_oscillation.pdf
- John McCarthy, *Ascribing Mental Qualities to Machines, 1979*
  mccarthy_ascribing_mental_qualities_to_machines_1979.pdf
- John Searle, *Minds, Brains, Programs, 1980* Searle_Minds, Brains, Programs 1980_scan.pdf

Week 4

[10/21] :: Day 8 - Midterm Project Intro

In-class:

- Review responses to Prompt 3.
- Discuss System Aesthetics.

Homework:

[10/23] :: Day 9 - Systems Aesthetics, Midterm Intro

Homework:

- Work on Mid-term project

Week 5

[10/28] :: Day 10 - In-Class Work

In-Class:

- Check in individually on mid-term project ideas.
- Work on midterm.

Homework:

- Midterm

[10/30] :: Day 11 - In-Class Work, Control Flow and Timings

In-Class:

- Work on midterm.
- timings and simultaneous action.s
  - non-blocking sequence with relative times relative.zip
  - non-blocking sequence with absolute timings absolute.zip
  - two simultaneous patterns simultaneous.zip
  - switch behavior with a pushbutton select_pattern.zip
  - try with multiple piezo tones, relay clocks, etc.

Week 6

[11/4] :: Day 12 - Mid-term Critique

In-class:

- Mid-term Critique

[11/6] :: Day 13 - Mid-term Critique continued

In-Class:

- Critique

Week 7

[11/11] :: Day 14 - Veterans Day

no class

[11/13] :: Day 15 - Networks, Xbees and Arduino FIO

Lecture: Xbee basics. Constructing networks.

- dxarts470_lecture7_xbee_basics.pdf

In-Class:

- Build xbee explorer and configure xbees. Follow Xbee tutorial.
- Setup Arduino FIO. Follow FIO tutorial.
- Try arduino xbee shield?
- Working in groups, establish a network between two xbees/FIOs.
  - Create a unique MY id number for your xbee using coolterm in order to keep your network private.
  - Run the examples from the Xbee tutorial to ensure the xbees are communicating properly.
  - Build a wireless sensor/actuator system with one xbee reading a spatial sensor and relaying data from it to the other xbee, which will turn something on in response. (spatial sensor: ir rangefinder, ultrasonic rangefinder, photocell, others)
  - Think about ways to make this system bi-directional.
- Experiment with Networks.

Homework

- Bertolt_Brecht_The_Radio_as_an_Apparatus_of_Communication.pdf
- Bertolt Brecht, *Lindberghflug,* 1929. (link)
- How does this piece realize (or fail to realize) Brecht's vision of the Radio as an Apparatus of Communication?
-

Week 8

[11/18] :: Day 16 - Sensors with XBees

In-class:

- Work with xbees, following activities from yesterday.
- Incorporate rangefinders or other spatial sensors in xbee sensor/actuator pairs:
  - Sharp IR Rangefinder
  - HC-SR04 Ultrasonic Rangefinder
- Discuss Brecht reading.

[11/20] :: Day 17 - Motion Capture

In-class:

- Introduce accelerometers.
- ADXL335 3-Axis Accelerometer
- MPU 6050 Six-Axis (Gyro + Accelerometer) Motion Tracking Device
- With Xbees, accelerometers.

Homework:

- Read Valentino Braitenberg. *Vehicles.* chap 1-4. Braitenberg_Vehicles.pdf and prepare to discuss in class on monday.
- OPTIONAL: Rodney Brooks. *Elephants Don't Play Chess.* 1990. rbrooks_elephants_dont_play_chess_1990.pdf
- Prompt 4: Bring in working Xbee transmit send/receive pairs of sensors/actuators. We do some live, improvised network art in class.

Week 9

[11/25] :: Day 18 -

In Class:

- In-class work with Prompt 4, live networking exercise.
- Braitenburg Discussion

Homework:

- Come up with final project ideas.

[11/27] :: Day 19 - State Machines

In-Class:

- State Machines. (turnstile, FSM, turing machine)
  - two states. a turnstile.
    - turnstile.zip
    - baroque_turnstile.zip
  - three states and conditional transitions. thermostat_state.zip
  - modeling with states. (emotional state) motivation_system.zip
- Emotional Thermostat
  - Cynthia Breazeal's Kismet.
  - *Designing Sociable Robots*, 2002. Chap 8, breazeal_chap8.pdf
- Describe a system as a state machine. Reviewed at the end of class.
- Check in on Final Project ideas

Week 10

[12/2] :: Day 18 - Guest Lecture, Q&A time

In-Class

- Guest lecture by DXARTS PhD Candidate Ha Na Lee.
- In class work on final projects.

[12/4] :: Day 19 -Q&A Time

In class work on final projects.

Finals Week

[12/9] :: Final Critiques

Extras

- Feedback/Thermostat Activities.
  - reading a temperature sensor. tempsensor.zip
  - thermostat. displays info to serial monitor. thermostat.zip
  - temperature playback. tempPlayback.zip
  - Proportional-integral-derivative (PID) control. (wikipedia) requires tuning. PID Library.
  -

Comments

+ Add a new comment.