USC School of Architecture

ARCH 588
Interactive Architecture: Computing and the Physical World
Units: 3
Fall 2015, Tuesday 9:00 – 11:50 AM

Location: Watt Hall (WAH 1) room 1 (in the basement)

Instructor: Kyle Konis
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Office Hours: by appointment (kkonis@usc.edu)
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Course Description
This course is as a seminar and workshop exploring physical interaction with computational media in real time. The widespread diffusion of sensing, computational, and communicative media into the physical realm presents an opportunity for exploring and constructing intelligent objects understood through dynamic and complex relationships of adaptation and improvisation to the environment, the site, and the human body. The course will chart and explore a range of approaches for integrating computation into the physical realm through a series of projects using physical computing prototyping tools.

Learning Objectives
This course is focused on self-directed, project-based learning within and experimental and collaborative setting. Students will design and develop projects that use sensors and microcontrollers to translate sensory input to control electro-mechanical devices such as motors, servos, lighting or other hardware in real time as well as collect, analyze and use sensed data by connecting their project with the internet. Internet of Things (IoT) technologies are transforming the building industry and have significant potential to improve the indoor environmental quality and energy performance of buildings.

Prerequisite(s): There are no prerequisites for the class.
Recommended Preparation: While no experience working with electronics is required, basic knowledge and willingness to learn programming and physical prototyping is assumed.

Course Notes
The course will be supported with materials posted on Blackboard.

Technological Proficiency and Hardware/Software Required
Students will be required to purchase their own microcontroller (e.g. Arduino board) and physical computing prototyping supplies. Additional, shared prototyping supplies (multi-meters, soldering irons, hand tools, will be supplied by the instructor).

Required Readings and Supplementary Materials
All required and supplemental reading materials will be posted on Blackboard and are included in the attached bibliography for reference. Students will be required to purchase a kit of prototyping materials as well as supply the materials for their final project. A mobile cart with an array of tools will be provided for shared use.

Description and Assessment of Assignments
Classes consist of lectures, student presentations and discussions based on assigned readings. The second half of most classes will be reserved for lab sessions where we will do hands-on exercises using the Arduino physical computing platform. The course projects will be divided into making dynamic objects, the use of sensing to enhance experience and understanding of the physical world, and the construction of a final class project determined by the student merging both environmental sensing and dynamic behavior.

Grading Breakdown
The grade shall be determined by student performance on weekly assignments and a substantial group project. The final project will be a group project where groups will consist of between 3 and 4 students. Students working in groups will be graded individually based on their contribution.

Assignment	**Points Possible**
Case study deep dive	10
Dynamic aperture (40 points)	
Part 1	5
Part 2	5
Part 3	5
Part 4	5
Part 5	20
*Final project (50 points)	
Part 1	5
Part 2	5
Part 3	30
Part 4	10
Total	**100**

*Note that the final project is a group project.

Assignment Submission Policy
All work will be submitted through Blackboard. Some projects will additionally require in-class demonstration.

Attendance and Late Work

Attending classes is a basic responsibility of every USC student who is enrolled in courses at the School of Architecture. Although any student should be evaluated primarily on their demonstrated knowledge through project development, papers, quizzes, and exams, the School believes important skills such as verbal presentation, design discussion and articulation of critical issues within each course are equal additional measures of demonstrated knowledge, particularly for our professional degree programs.

More than two unexcused absences may result in a failing grade. More than two instances of unexcused tardiness will be counted as an absence. Work turned in late will not be accepted.

Any student not in class within the first 10 minutes is considered tardy, and any student absent (in any form including sleep, technological distraction, or by leaving mid class for a long bathroom/water break) for more than 1/3 of the class time can be considered fully absent. If arriving late, a student must be respectful of a class in session and do everything possible to minimize the disruption caused by a late arrival. It is always the student's responsibility to seek means (if possible) to make up work missed due to absences, not the instructor's, although such recourse is not always an option due to the nature of the material covered.

Course Schedule: A Weekly Breakdown

	Topics/Daily Activities	**Readings and Homework**	**Deliverable/ Due Dates**
Week 1 8/25	**Lecture**: Overview of physical computing and IoT, prototyping and iterative development. **Lab**: Installing the IDE and basic code examples.	Case Study Assignment handed out Read: Digital Ground, Part 1,2	
Week 2 9/1	**Lecture**: Architectural applications of physical computing and IoT. **Lab**: Arduino programming, basic soldering.	Dynamic Aperture Assignment handed out Read: The Internet of Things, CH 1-3.	In-class presentation of Case Study Assignment. Powerpoint ***DUE to BB by 11:59 PM MON 8/31.**
Week 3 9/8	**Lecture**: Designing environmentally responsive systems. **Lab**: Controlling motors, grasshopper.	Assignment 3 handed out Read: TAM, Ch 1-4.	Dynamic Aperture **Part 1**: Physical mock-up **DUE 9/8**
Week 4 9/15	**Lecture**: Fabricating responsive systems. **Lab**: Cont. controlling motors.	Assignment 4 handed out Reading: GSWA Ch 1-3.	Dynamic Aperture **Part 2**: Grasshopper mock-up **DUE 9/15**
Week 5 9/22	**Lecture:** Environmental sensing. **Lab**: Thermal and light sensors.	Assignment 5 handed out Reading: Wiring to the Sky	Dynamic Aperture **Part 3**: Digitally-fabricated mock-up **DUE 9/22**
Week 6 9/29	**Lecture:** Using environmental data. **Lab**: Data collection, analysis and visuization.	Assignment 6 handed out Reading: GSWA Ch 4-5.	Dynamic Aperture **Part 4**: Working prototype **DUE 9/29**
Week 7	Project demos and	Final project proposal	Dynamic Aperture **Part 5**:

10/6	review. Discussion of final group project. **Lab**: T.B.D.	assignment handed out Reading: PC Ch 1-4.	Final prototype and photo / video documentation **DUE 10/6**
Week 8 10/13	Students present proposals and form groups for final projects.	Reading: PC Ch 5-8.	In-class presentation of final project proposal. ***Powerpoint DUE to BB by 11:59 PM MON 10/12.**
Week 9 10/20	**Lab**: Final group project refinement.	Final project assignment handed out (4 Parts)	
Week 10 10/27	**Lecture:** Making buildings "Smart." **Lab**: Working with wifi and xbee networks.	Reading: CPUC CA EE Strategic Plan.	Final Project **Part 1**: Digital prototype (and materials list) **DUE 10/27.**
Week 11 11/3	**Lecture:** Prototyping **Lab**: Making connections, effective workflows and testing	Reading: Leveraging Ubiquitous Computing	
Week 12 11/10	**Lecture:** 3D printing workflows. **Lab**: Working with Makerbot.	Group Assignment 3 handed out	Final Project **Part 2**: Physical prototype **DUE 11/10.**
Week 13 11/17	Supervised work on final projects		
Week 14 11/24	Supervised work on final projects		
Week 15 12/1	In-class presentation of final working project prototypes.		Final Project **Part 3**: Final, working protoytpe **DUE 12/1.**
FINAL			Final Project **Part 4**: Report ***DUE Thursday December 10, 2:00 PM. Upload to BB.**

Statement on Academic Conduct and Support Systems

Academic Conduct
Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Section 11, *Behavior Violating University Standards*https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions/. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct/.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* http://equity.usc.edu/ or to the *Department of Public Safety* http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us. This is important for the safety whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. *The Center for Women and Men* http://www.usc.edu/student-affairs/cwm/ provides 24/7 confidential support, and the sexual assault resource center webpage sarc@usc.edu describes reporting options and other resources.

Support Systems
A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* http://dornsife.usc.edu/ali, which sponsors courses and workshops specifically for international graduate students. *The Office of Disability Services and Programs* http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.htmlprovides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information http://emergency.usc.edu/*will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.

Bibliography

Banzi, Massimo. (2011). Getting Started with Arduino. O'Reilly Media.

California Public Utilities Commission (CPUC). (2013). *California Energy Efficiency Strategic Plan*. http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/eesp/

Greenguard, Samuel. (2015). The Internet of Things. MIT Press.

McCullough, Malcolm. Digital Ground. (2005). Architecture, Pervasive Computing, and Environmental Knowing. MIT Press.

Konis, K. *Wiring to the Sky*. (2013). Adaptive Architecture: Proceedings of the 33rd Annual Conference of the Association for Computer Aided Design in Architecture (ACADIA). October 24-26, 2013, Cambridge Ontario, Canada.

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Negroponte, N. (1973). The Architecture Machine: Toward a More Human Environment. MIT press.

O'Sullivan, Dan and Tom Igoe. (2004). Physical Computing: Sensing and Controlling the Physical World with Computers. Thomson Publishing.