



**ARC 3041H : Selected Topics in Architecture, Technology and Ecology  
Interactive Spaces and Responsive Environments**

**Monday 12:00 a.m. - 2:00 p.m. Room 104**

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**Office Hours: TBA**

**COURSE DESCRIPTION**

This course explores the design of responsive environments and architecture-based human-computer interaction, focusing on the physical embodiment of computational media. Responsive environments allow for communication and interactivity through augmented physical surfaces (e.g. walls, ceilings, windows), ambient media (e.g. light, sound, airflow, water-flow) and kinetic elements within physical environments.

The seminar combines lecture and workshop sessions to develop both, a theoretical framework for interactivity as well as the technical knowledge and skills to implement and test it with prototypes and architectural installations.

The workshops include tutorials in programming and digital electronics to prepare students for designing simple circuits and interfaces. Particular attention is given to the "Processing" programming environment and the "Arduino" electronics prototyping platform.

Course assignments consist in a short class presentation, a small practical project, and a final built prototype or installation.

**COURSE OBJECTIVES**

The ambition of this course is to provide a theoretical framework and to build technical skills for the design of interactive environments. The theoretical part will explore, discuss, and critically evaluate approaches to responsive environments design and its emerging discourse. The practical part will involve design experimentation and model construction using robotics technologies. The final project involves the design of a public space, where concept of motion and interactivity is an essential part of the program.

**SCHEDULE**

The schedule for class sessions is subject to change yet a preliminary schedule is as follows:

Session01: Monday, September 14, 2009  
Introduction to interactive spaces and responsive environments  
Setting up for Arduino and Processing  
A case study is assigned to each student

Session02: Monday, September 21, 2009  
Fundamentals of Programming 01  
Students will present their assigned case studies in Pecha Kucha format. [Under this format a presenter shows maximum of 20 images for 20 seconds apiece, for a maximum total time of 6 minutes, 40 seconds.]

Session03: Monday, September 28, 2009  
Fundamentals of Programming 02  
First Assignment is discussed with students

Session04: Monday, October 05, 2009  
Fundamentals of Physical Computing 01  
Output devices or actuators  
Active systems

Monday, October 12, 2009  
Thanksgiving Day – No Classes

Session05: Monday, October 19, 2009  
Fundamentals of Physical Computing 02  
Input devices or sensors  
Reactive systems

Monday, October 26, 2009  
School-wide workshop – No Classes

Session06: Monday, November 02, 2009  
First Assignment is due [Midterm review]

Session07: Monday, November 09, 2009  
Fundamentals of Physical Computing 03  
Conditioning the space in terms of actuation based on what is sensed in the context  
Interactive systems

Session08: Monday, November 16, 2009  
Designing for Interaction 01  
Connecting physical input and virtual Output  
Connecting virtual input and physical Output

Session09: Monday, November 23, 2009  
Designing for Interaction 02  
Video/image processing and computer vision  
Final Assignment is discussed with students

Session10: Monday, November 30, 2009  
Designing for Interaction 03  
Audio processing and computer audition  
Internet connection and tele-presence

Session11: Thursday, December 03, 2009  
Make-up class for the class missed on the Thanksgiving day  
Data acquisition and Visualization  
Memory of things past  
Reading from memory and writing to memory  
A two-pager discussing student's ideas for final project is due

Session12: Friday, December 04, 2009  
One-on-one discussions about technical implementation of the proposed scenarios – Code debugging and troubleshooting

Final Review: TBA during the December 7-17 period

## **EVALUATION**

Evaluation will be carried out in accordance with the Graduate Grading and Evaluation Practices Policy The University of Toronto, School of Graduate Studies, 2007 – 2008 Calendar, pages 36 to 41 explains that policy in detail.

Grade breakdown:  
Class participation

10%

Class presentation of assigned case study:	10%
Midterm project:	30%
Final project and submitted paper in CHI Short Format available at <a href="http://www.acm.org/sigchi/chipubform/">http://www.acm.org/sigchi/chipubform/</a>	40 + 10%

### **ACADEMIC PLANNING FOR H1N1**

Students are advised to consult the university's preparedness site (<http://www.preparedness.utoronto.ca>) for information and regular updates regarding procedures relating to H1N1 planning and individual student responsibilities.

### **ACCESSIBILITY NEEDS**

The University of Toronto is committed to accessibility. If you require accommodations for a disability, or have any accessibility concerns about the course, the classroom or course materials, please contact Accessibility Services as soon as possible: [disability.services@utoronto.ca](mailto:disability.services@utoronto.ca) or <http://studentlife.utoronto.ca/accessibility>.

### **PLAGIARISM**

University of Toronto code of Behaviour on Academic Matters states that "it shall be an offense for a student knowingly: to represent as one's own any idea or expression of an idea or work of another in any academic examination or term test or in connection with any other form of academic work, i.e., to commit plagiarism."

For accepted methods of standard documentation formats, including electronic citation of internet sources please see the U of T writing website at: <http://www.utoronto.ca/writing/document.html#elect>

The full Code of Behaviour regulations could be found from consulting <http://www.sgs.utoronto.ca/current/calendar/regulations16.asp>

### **WRITING AND ENGLISH LANGUAGE**

As well as the faculty writing support, please see English Language and writing support at University of Toronto: <http://www.sgs.utoronto.ca/english/> and <http://www.utoronto.ca/writing/advise.html>. Students have commented that they found the latter address extremely helpful for writing term papers.

The following are also useful:

Sylvan Barnett, *A Short Guide to Writing About Art*. 5-7th edition (New York: Harper-Collins, 1997)  
William Strunk Jr., E.B. White. *The Elements of Style* (New York: MacMillan Publishing)

### **LATE WORK**

All assignments are due in class at the specified time and date. The final paper/project report/project video documentation is due via email, No later than on Thursday, 17th of December before 6PM.  
Late assignments will not be accepted (except in the case of documented illness or special circumstances) and will be penalized five (5) percent of the assignment grade for each business day.

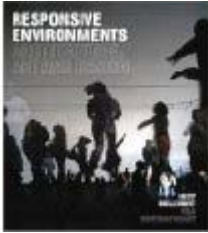
In the case of illness or other special circumstance, notification should be given to the instructors and the Program Office as soon as possible and before the deadline in question.

Late work submitted after the final day of classes, Monday, December 7, 2009 is not acceptable without prior written permission from the Program Director.

## READINGS

Reading material is available in the class folder in electronic format–PowerPoint presentations and text files–or on reserve at the school’s library for short term loans.

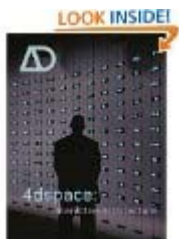
Following is a list of relevant and highly recommended books–most but not all are on reserve:



Responsive Environments: architecture, art and design (V&A Contemporaries) by Lucy Bullivant



4dsocial: Interactive Design Environments (Architectural Design) by Lucy Bullivant



4dspace: Interactive Architecture (Architectural Design) by Lucy Bullivant



iA #1 (Interactive Architecture) by Kas Oosterhuis and Xin Xia



iA #2 (Interactive Architecture) by Kas Oosterhuis and Xin Xia



Flexible: Architecture that Responds to Change by Robert Kronenburg



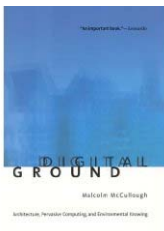
Responsive Architectures : Subtle Technologies by Philip Beesley; Sachiko Hirose; Jim Ruxton; Marion Trankle; Camille Turner



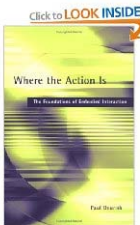
Hyperbodies by by Kas Oosterhuis



Flying Dutchman: Motion in Architecture by Kari Jormakka



Digital Ground: Architecture, Pervasive Computing, and Environmental Knowing by Malcolm McCullough



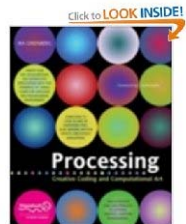
Where the Action Is: The Foundations of Embodied Interaction by Paul Dourish



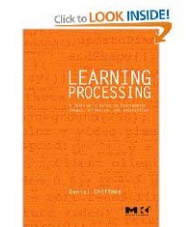
Designing Interactions by Bill Moggridge



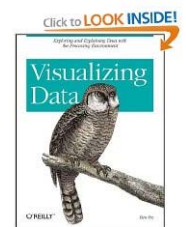
Processing: A Programming Handbook for Visual Designers and Artists by Casey Reas



Processing: Creative Coding and Computational Art (Foundation) by Ira Greenberg



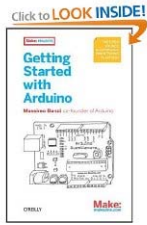
Learning Processing: A Beginner's Guide to Programming Images, Animation, and Interaction (Morgan Kaufmann Series in Computer Graphics) by Daniel Shiffman



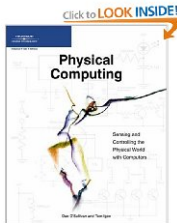
Visualizing Data: Exploring and Explaining Data with the Processing Environment by Ben Fry



Algorithms for Visual Design Using the Processing Language by Kostas Terzidis



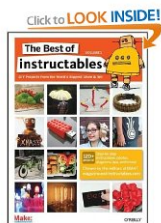
Getting Started with Arduino (Make: Projects) (Paperback) by Massimo Banzi



Physical Computing: Sensing and Controlling the Physical World with Computers by Tom Igoe



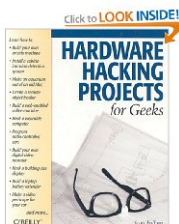
Making Things Talk: Practical Methods for Connecting Physical Objects by Tom Igoe



The Best of Instructables Volume I: Do-It-Yourself Projects from the World's Biggest Show & Tell (v. 1)



The Best of MAKE (Make 75 Projects from the pages of MAKE) (Paperback) by Mark Frauenfelder (Editor), Gareth Branwyn (Editor)



Hardware Hacking Projects for Geeks by Scott Fullam



## Creative Code: Aesthetics + Computation by John Maeda

Related articles and book chapters are as follows:

Brooks, R. Allen. "Robots in Our Lives." in *Flesh and Machines : How Robots will Change Us*. New York : Pantheon Books c2002. 114-126

Chesley, Harry. "Early Applications." In *Nanotechnology Molecular Speculations on Global Abundance*, edited by BC Crandall, Cambridge: MIT Press, 2000. 89-105

Conrad, Erik. "Rethinking the Space of Intelligent Environments." In *What Matters?: Proceedings of the First International Conference on Critical Digital , 2007 Harvard Graduate School of Design, Cambridge, USA*, edited by Kostas Terzidis, Limited Edition, 2007.

Cuff, Dana. "Immanent Domain: Pervasive Computing in the Public Realm." *Journal of Architectural Education* 57, no.1(September 2003): 43-49.

Haque, Osman. "Dressing the Shadows of Architecture." *Korean Design Journal* (2005)  
<http://www.haque.co.uk/papers/dressingshadowsofarch.pdf> (accessed September 2, 2009).

Haque, Osman. "The Choreography of Sensations." In *VSMM 2004 : Proceedings of the Tenth International Conference on Virtual Systems and Multimedia, 17-19 November, 2004 Softopia Japan, Ogaki City, Japan: Hybrid Realities & Digital Partners*, 4th ed. edited by Hal Thwaites, IOS Press, March 9, 2005.  
<http://www.haque.co.uk/papers/choreography-of-sensations.pdf> (accessed September 2, 2009).

Haque, Osman, Hugh Dubberly, and Paul Pangaro, "What is Interaction? Are There Different Types?." *ACM Interactions* (January 2009) <http://mags.acm.org/interactions/20090102/?pg=71> (accessed September 2, 2009).

*Interactions* xvi, no 1 ( January/February 2009)

Ishii, Hiroshi, and B. Ullmer. "Tangible bits: towards seamless interfaces between people, bits and atoms." In *CHI'97, 1850-1920: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems Held in Atlanta, GA 22-27 March 1997*, edited by S. Pemberton, New York: ACM, 1997. 234-241

Johnson, Steven. "Here Comes Everybody!." in *Emergence : the Connected Lives of Ants, Brains, Cities, and Software*. New York : Scribner, c2001. 11-23

Jormakka, Kari. "Space and Motion." in *Flying Dutchmen Motion in Architecture*. Basel ; Boston ; Berlin : Birkhäuser, c2002. 70-87

Karaganis, Joe, ed. *Structures of Participation in Digital Culture*. New York: Social Science Research Council, c2007.

Kwinter, Sanford. "The Computational Fallacy." *Thresholds* 26,(2003): 90-92.

Latour, Bruno. "Alternative Digitality." *Domus* 870,( May 2004): 64-65.

Löwgren , Jonas. "Five things I believe about the aesthetics of interaction design." Position paper for Dagstuhl seminar on The study of visual aesthetics in human-computer interaction, Draft, June 3, 2008.  
[http://webzone.k3.mah.se/k3jolo/Material/aesthetics\\_of\\_ixd.pdf](http://webzone.k3.mah.se/k3jolo/Material/aesthetics_of_ixd.pdf) (accessed September 2, 2009).

Manovich, Lev. "The poetics of augmented space." *Visual Communication* 5, no.2 (2006): 219-240.

Pask, Gordon. "Architectural Relevance of Cybernetics." *Architectural design* 39, (1969): 494-496.

Roussos, George. "Location Sensing Technologies and Applications." JISC Techwatch Report, August, 2002. <http://www.jisc.ac.uk/whatwedo/services/techwatch/reports/horizonscanning/hs0208.aspx> (accessed September 2, 2009).

Weiser, Mark. "The Computer for the Twenty-First Century." *Scientific American* 265, no. 3 (September 1991): 9-21.

### **FINAL DUE DATE**

The final due date for course work is Monday, December 7th, during the exam and reviews week. The final paper/project report/project video documentation is due via email, No later than on Thursday, 17th of December before 6PM.

### **REQUIREMENTS**

There is no prerequisites. No programming skills are necessary.

All student are required to purchase the package of equipments necessary for actual robotic experiments (about \$180) before the second session of the class from the provider with whom the arrangements are already made.