ECE 4001/7001 Architectural Robotics 4 credits

Lafferre Hall, room C1243. Monday and Wednesday, 10am – 11:50am

Instructor: Dr. Marjorie Skubic
skubicm@missouri.edu
office: 329 EBW
phone: 882-7766

Teaching Assistant: Mr. Zhiyu (Eric) Huo, Electrical and Computer Engineering PhD student
Consulting Instructor: Dr. Newton D'Souza, Department of Architectural Studies
Guest Reviewer: Dr. Bimal Balakrishnan, Department of Architectural Studies

Prerequisites: Programming experience or experience using a computer-aided design (CAD) system; junior, senior, or graduate standing

Course Description
Architectural robotics has been defined as "intelligent and adaptable built environments (featuring embedded robotic components) that sense, plan, and act" [1]. This course will cover the basic concepts required for understanding, developing, and testing embedded robotic systems for the built environment. Students will work together in teams in a studio-style format which emphasizes hands-on projects to develop working prototypes. The goal is to offer students an opportunity for creativity in a multi-disciplinary setting.

Course Structure
The course follows the studio-style format for hands-on, project-based learning. Students will meet in the lab in two blocks per week. The beginning of the Monday class will be spent discussing the assigned readings. Students will be expected to read the weekly reading assignments before coming to class. The remaining class time will be spent working on collaborative projects. Throughout the course, instructors will offer comments, critiques, and suggestions as feedback on the projects. Student teams will be provided with embedded robotic components, including the Arduino micro-controller, sensors, motors, lego pieces and other structural elements. Assignments will include enough flexibility to encourage design creativity.

Assessment and Grading
For each project assignment, student teams will give a presentation and demonstration of their working prototype to the class, and all students will have an opportunity to ask questions and offer their comments. Project grades will be based on the work as presented and documented.

ECE 4001
10% Project #1. Working with the Arduino
30% Project #2. An in-depth project
25% Project #3. An exploratory project
25% Documentation of all assignments submitted on-line, which will include a needs analysis, preliminary designs considered, rationale for the final design, and the final project report
10% Class participation and attendance

ECE 7001
8% Project #1. Working with Arduino
28% Project #2. An in-depth project
23% Project #3. An exploratory project
23% Documentation of all assignments submitted on-line, which will include a needs analysis, preliminary designs considered, rationale for the final design, and the final project report

10% Class participation and attendance
8% Design project for graduate credit.

Note: The class participation grade is a subjective score. To score well, you must convince the instructors that you are actively engaged in the class.

Class Attendance
Due to the class format, it is especially important that students attend every class. Attendance will be taken in the first 20 minutes of class, and students will lose grade points for unexcused absences. Valid excuses are debilitating illness or other life crisis; these should be communicated by email to Dr. Skubic at the earliest possible date. Upon your return to class, present any supporting documentation for your absence (e.g., medical form) stapled to a printed copy of the email. Written excuses submitted in this way will be considered reasonably on a case by case basis. Undocumented excuses and late arrivals will be counted as an absence.

Course Philosophy
The class will operate in a cooperative spirit. Students are encouraged to discuss ideas and problems with each other, even members outside your group. You may also want to use a technique developed by another student or group; this is acceptable as long as you *give them credit* in your reports and discussions.

Course Material
Reading assignments will be available on-line through login on a blackboard site.
Other reference material may come from the following:
L. Nocks, *The Robot: The Life Story of a Technology*, Johns Hopkins University Press, 2008.
R. Arkin, *Behavior-Based Robotics*, MIT Press, 1998
R.R. Murphy, *Introduction to AI Robotic*s, MIT Press, 2001
Fred Martin, *Robotic Explorations*, Prentice-Hall, 2001

Email Communication
You will be expected to check your University of Missouri email account at least once a day for potential messages regarding this class.

Academic Dishonesty
Academic integrity is fundamental to the activities and principles of a university. All members of the academic community must be confident that each person's work has been responsibly and honorably acquired, developed, and presented. Any effort to gain an advantage not given to all students is dishonest whether or not the effort is successful. The academic community regards breaches of the academic integrity rules as extremely serious matters. Sanctions for such a breach may include academic sanctions from the instructor, including failing the course for any violation, to disciplinary sanctions ranging from probation to expulsion. When in doubt about plagiarism, paraphrasing, quoting, collaboration, or any other form of cheating, please see Dr. Skubic in advance.

From Webster`s New Collegiate Dictionary, to plagiarize is "to steal and pass off (the ideas or words of another) as one`s own use without crediting the source."
Please supply supporting references where appropriate. If phrases are copied verbatim, they must be shown as direct quotes. Attempts at plagiarism will be given a grade of 0 points.

Disabilities
If you anticipate barriers related to the format or requirements of this course, if you have emergency medical information to share with me, or if you need to make arrangements in case the building must be evacuated, please let Dr. Skubic know as soon as possible. Please see her privately after class, or at her office, EBW 329.

If disability related accommodations are necessary (for example, a note taker, extended time on exams, captioning), please register with the Office of Disability Services (http://disabilityservices.missouri.edu), S5 Memorial Union, 573- 882-4696, and then notify Dr. Skubic of your eligibility for reasonable accommodations. For other MU resources for students with disabilities, click on "Disability Resources" on the MU homepage

Intellectual Pluralism
The University community welcomes intellectual diversity and respects student rights. Students who have questions concerning the quality of instruction in this class may address concerns to either the Departmental Chair or Divisional leader or Director of the Office of Students Rights and Responsibilities (http://osrr.missouri.edu/). All students will have the opportunity to submit an anonymous evaluation of the instructor(s) at the end of the course.

Course Topics

1. Studio culture of collaboration, critiques and peer reviews
2. Arduino basics
3. Architectural robotics: definitions, research and practices
4. Human factors
5. Physical environment: spatial composition, aesthetics and experience
6. Design and evaluation of architectural robotics for kids
7. Tangible, embedded and embodied computing + "The Vision"
8. Continuum robots and other bio-inspired robots
9. Architectural robotics: formative documents
10. Architectural robotics for aging in place
11. Accessible design
12. Assistive and social robotics case study: ART (Assistive Robotic Table)
13. Machine learning and intelligence
14. Refining the prototype
15. Key algorithms for robotic structures
16. Conclusions and lessons learned

Acknowledgements and References
The course has been adapted from a course offered at Clemson University. Dr. Keith Green has offered to share his experiences and course readings.

[1] M. Gross and K. Green, "Architectural Robotics, Inevitably," ACM Interactions Magazine, vol. 19, no. 1, pp. 28-33, 2012.
[2] A.D. Kapadia, I.D. Walker, K.E. Green, J.C. Manganelli, H. Houayek, A.M. James, V. Kanuri, T. Mokhtar, I. Siles, and P. Yanik, "Rethinking the Machines in Which We Live: A Multidisciplinary Course in Architectural Robotics," IEEE Robotics and Automation Magazine, vol. 21, no. 3, pp. 143-150, 2014.
[3] http://workgroups.clemson.edu/AAH0503_ANIMATED_ARCH/academics-ARCHrobotics.htm