ECE 8680: Architectural Robotics
Time: Tuesday 9:30-12:15
Instructor: Ian D. Walker, iwalker@clemson.edu
Class TA: Michael Wooten, mbwoote@clemson.edu
Office hours: by appointment (set up via email), appointments conducted via Zoom
Course modality: online synchronous (via Zoom, invitation emailed to students shortly before each class)

Prerequisites: ECE 6550, Introduction to Robot Manipulators, or instructor consent
Required Materials: Text, *Architectural Robotics*, Keith E. Green, MIT Press, 2016, required. Students are also required to have a laptop computer, internet connectivity capable of transmitting and receiving video, a video camera, a microphone, and a cell phone.

I.   Course Description:
A 3-credit course for students focused on understanding, development and testing of robotic systems for the built environment. Students will develop working robotic prototypes responsive to challenges and opportunities of living in the built and natural environments today.

II.   Topical Outline and Schedule
       1. Architectural Robotics: Definitions | 8/25
Reading: *The Thousand Dreams of Stellavista*, J.G. Ballard; Introduction to Project 1
       2. Project Proposals| 9/1
Project 1 student proposals
       3. Refining the Prototypes | 9/8
Reading: Text, Chapters 1 and 2
       4. Project 1 Presentations | 9/15
Project 1 presentations; Introduction to project 2
       5. Project Proposals| 9/22
Project 2 student proposals
       6. Refining the Prototypes | 9/29
Reading: Text, Chapters 3-5
       7. Refining the Prototypes| 10/6
Reading: Text, Chapters 6-8
       8. Project 2 Presentations | 10/13
Project 2 presentations; Introduction to final project
       9. Project Proposals| 10/20
Final Project student proposals
       10. Refining the Prototypes | 10/27
       11. ***No Class: Fall Break | 11/3***
Reading: Text, Chapters 9-12
       12. Refining the Prototypes | 11/10
       13. Refining the Prototypes | 11/17
       14. No Class: Thanksgiving holiday | 11/24
       15. Final Project Presentations | 12/1

III.   Course Objectives and Learning Outcomes:
The gradual embedding of robotics throughout the built environment will have a broad impact on society as these technologies support and, in some cases, augment everyday work, school, entertainment, and leisure.

The objective of this course is *to identify and investigate opportunities and challenges in the emerging field of robotics technologies embedded in the built environment*. By the completion of this course, students will cultivate an understanding of how new technologies and human-centric design methodologies can be applied to improve traditional complex systems, and will demonstrate an ability to realize in working prototypes architectural robotic artifacts responsive to challenges and opportunities in an increasingly digital society. More broadly, this course aims to cultivate new ways in which complex engineered systems can be designed to respond to human needs and wants.

IV.   Assessment of Student Performance and Grading Policies:
There will be three design project assignments. In each assignment, students will demo a working "architectural robotic" environment and provide its documentation (as described below). Throughout this course – an intimate and intensive "conversation" between students and faculty members – students will have ample opportunity to receive feedback on their work. Students will receive a grade in response to the work presented and documented, weighted as follows:

• (20%) **project 1** (Introductory, concept-driven)
• (30%) **project 2** (An in-depth project TBD)
• (30%) **final project** (A refinement of earlier projects TBD)
• (20%) **documentation** of all project assignments on a CD.
Grading scale: 90-100 A; 80-89 B; 70-79 C; below 70 F

There are two necessary requirements for each of the assignments:
1. *Your demo must employ at least one sensor that actuates one or more motors to move physical mass.* (Your demo might also, potentially, control lighting, a computer display, and/or an audio device).
2. *Your demo must move physical mass to alter, spatially, the environment*.
The first requirement is simpler, the second, less tangible. We ask that your demos be *spatial*: that enclosures, structural systems, physical boundaries, and/or key components (e.g. furniture) of a local environment "morph" (e.g. fold, bend, twist, undulate, elevate, incline, rotate, close, contract, soften, swell, breathe …) in response to at least one phenomenon detected by one or more sensors. In this way, architecture (or more broadly, the built environment) is a *dynamic system* made of physical matter, digital information, inhabitants and other living things *in motion*.

Deliverables for each assignment:
For each assignment, students will prepare and present a brief (10 minute) PowerPoint presentation proposing their project concept (a "scenario" indicating what the artifact created will do, along with a design concept for creating the artifact, and components/materials projected as needed to physically realize the demonstration of it). For each project demonstration, students will present updated versions of the proposal PowerPoint, demonstrate (over Zoom) the working prototype, and show a 2-3 minute video describing the project. The video will be the primary deliverable for each project.

NOTE: Examples of prior student projects and supporting materials are provided on-line by the instructor at http://www.clemson.edu/ces/caarl/classes.html under ECE 8680: Architectural Robotics.

V.   Attendance and Course Cancellation Policy

Online attendance is optional, but students are responsible for all material covered in class. If instructor is more than 15 minutes late for class (Zoom), students can assume no class that day.

VI.   Accessibility Statement

Clemson University values the diversity of our student body as a strength and a critical component of our dynamic community. Students with disabilities or temporary injuries/conditions may require accommodations due to barriers in the structure of facilities, course design, technology used for curricular purposes, or other campus resources. Students who experience a barrier to full access to a class should let the instructor know and make an appointment to meet with a staff member in Student Accessibility Services as soon as possible. You can make an appointment by calling 864-656-6848 or by emailing studentaccess@lists.clemson.edu. Students who receive Academic Access Letters are strongly encouraged to request, obtain, and present these to their instructors as early in the semester as possible so that accommodations can be made in a timely manner. It is the student's responsibility to follow this process each semester. You can access further information here: http://www.clemson.edu/campus-life/campus-services/sds/.

VII.   Title IX Statement

Clemson University is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender, pregnancy, national origin, age, disability, veteran's status, genetic information or protected activity in employment, educational programs and activities, admissions and financial aid. This includes a prohibition against sexual harassment and sexual violence as mandated by Title IX of the Education Amendments of 1972.

VIII.   Safe Campus

Clemson University is committed to providing a safe campus environment for students, faculty, staff, and visitors. As members of the community, we encourage you to take the following actions to be better prepared in case of an emergency:

   a.   Ensure you are signed up for emergency alerts (https://www.getrave.com/login/clemson)
   b.   Download the Rave Guardian app to your phone (https://www.clemson.edu/cusafety/cupd/rave-guardian/)
   c.   Learn what you can do to prepare yourself in the event of an active threat (http://www.clemson.edu/cusafety/EmergencyManagement/)

IX.   Academic Integrity

As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a 'high seminary of learning.' Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form. In instances where academic standards may have been compromised, Clemson University has a responsibility to respond

appropriately to charges of violations of academic integrity. Further information on Academic Integrity can be found in the *Undergraduate Announcements* and in the *Graduate School Policy Handbook*.

X.   Copyright Statement

Materials in this course are copyrighted. They are intended for use only by students registered and enrolled in this course and only for instructional activities associated with and for the duration of the course. They may not be retained in another medium or disseminated further. They are provided in compliance with the provisions of the Teach Act. Students should be reminded to refer to the Use of Copyrighted Materials and "Fair Use Guidelines" policy in on the Clemson University website for additional information: https://clemson.libguides.com/copyright.

XI.   Modification Statement

The instructor reserves the right to modify any aspect of the syllabus at any time during the semester for reasons including but not limited to COVID-related situations.

8/5/2020