ECE 6465 Robots & Humans

Instructor: Joanne Bechta Dugan, Dept of Electrical and Computer Engineering

Catalog Description: Human Robot Interaction. Interactions between robots and humans are influenced by form, function and expectations. Quantitative techniques evaluate performance of specific tasks and functions. Qualitative techniques are used to evaluate the interaction and to understand expectations and perceptions of the human side of the interaction. Students use humanoid robots to develop and evaluate interactions within a specific application context.

Course Structure: Mix of lecture and laboratory approximately half-and-half. Each week there is one 1.25-hour lecture/discussion, one in-lab assignment. There are also about 10 collaborative assignments wherein student teams (up to 3) develop and evaluate tasks and interactions.

Intended audience: Masters-level students in any field related to cyber-physical or embedded systems. The course is open to all engineering graduate students; students are expected to be able to program in python.

Topics:

- Evaluation of HRI
    - Task-oriented quantitative metrics
    - Social science experiment methods
        - Science of robotics
    - Human studies methods in HRI
- Expression & Perception
    - Robot gestures/posture/movement
    - Visual displays, lights, colors
    - Audio processing, speech recognition
    - Audio expression, beeps and other sounds
    - Vision, object recognition
    - Other sensing (accelerometer, gyro, sonar, etc.)
- Inner Life Modeling (emotions, motivation, relationships)
    - Emotions and how they change in relation to the task being performed
    - Motivation of robot system and how that forms behavior
    - Relationship factors that shape robot behavior
    - Emotions & motivations affect decisions and are expressed through gestures, posture, etc.
- Applications & Safety
    - Assistive Robots
    - Therapy Robots
    - Search & rescue
    - Safety issues (esp. AI safety)

Lab assignments

0. ***Dance with me*** Learn the timeline, posing, etc. , add music, start on some signal from user.
1. ***Hello it's me*** facial recognition, greet and converse with each team member (different conversational style with each person)
2. ***Pin the tail on the donkey*** Requirement: make the robot touch a specific place or pick up an item and do something with it. Because there is no sensory feedback when something is touched or picked up, the project involves the coordination of sensing and motion.
3. ***Play a musical instrument.*** We have a small collection of child-sized percussive musical instruments that range from simple (triangle, maraca, wood blocks) to slightly more complex (a set of 8 bells with different tones, xylophone) to a child-sized baby grand piano.
4. ***Play some game with a human*** We want the game to require interactions between the players so as to provide an opportunity to work with emotions and personalities later.
5. ***Evaluate the game using human subjects***. Design and implement an evaluation with humans
6. ***Play a game with personality.*** Develop a personality for the robot that is expressed through and affected by the interactions. Evaluate with human study. (several weeks)
7. ***Field games.*** Inspired by 2015 DARPA robotics challenge***.*** Events include bowling, golf, ring toss, obstacle course. Students are assigned to one of 2 teams that compete against each other for points. Team reps develop rules of engagement and can issue challenge tasks. (several weeks)

Assessments:

- Projects/labs are evaluated in terms of performance, quality of code, written documentation, degree of difficulty, team interactions, project-specific evaluation metrics and success criteria. This is the bulk of the grade.
- Several written assignments based on readings
- Class discussions
- Occasional quizzes/test

Partial Reading list (updated at each offering)

Michael A. Goodrich and Alan C. Schultz. 2007. Human-robot interaction: a survey. *Found. Trends Hum.-Comput. Interact.* 1, 3 (January 2007), 203-275.

C Bartneck, D Kulić, E Croft, S Zoghbi. Measurement instruments for the anthropomorphism, animacy, likeability, perceived intelligence, and perceived safety of robots. *International journal of social robotics* 1 (1), 71-81

Aaron Steinfeld, Terrence Fong, David Kaber, Michael Lewis, Jean Scholtz, Alan Schultz, and Michael Goodrich. 2006. Common metrics for human-robot interaction. In *Proceedings of the 1st ACM SIGCHI/SIGART conference on Human-robot interaction* (HRI '06). ACM, New York, NY, USA, 33-40.

Astrid Weiss , Regina Bernhaupt , Michael Lankes , Manfred Tscheligi. The USUS evaluation framework for human-robot interaction. *AISB2009: Proceedings of the Symposium on New Frontiers in Human-Robot Interaction*.

V. Groom, L. Takayama, P. Ochi and C. Nass, I am my robot: The impact of robot-building and robot form on operators, *2009 4th ACM/IEEE International Conference on Human-Robot Interaction (HRI)*, La Jolla, CA, 2009,

pp. 31-36.

L. Takayama, Toward a science of robotics: Goals and standards for experimental research. RSS workshop on good experimental methodology in robotics, 2009.

Leila Takayama, Victoria Groom, and Clifford Nass. 2009. I'm sorry, Dave: i'm afraid i won't do that: social aspects of human-agent conflict. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '09). ACM, New York, NY, USA, 2099-2108.

James E. Young, JaYoung Sung, Amy Voida, Ehud Sharlin, Takeo Igarashi, Henrik I. Christensen, Rebecca E. Grinter. Evaluating Human-Robot Interaction Focusing on the Holistic Interaction Experience. International Journal of Social Robotics, January 2011, Vol. 3, Issue 1, pp 3-53.

Cindy Bethel and Robin Murphy, Review of Human Studies Methods in HRI and Recommendations, . International Journal of Social Robotics, December 2010, Vol. 2, Issue 4, pp 347-359.

Dario Amodei, Chris Olah, Jacob Steinhardt, Paul Christiano, John Schulman, Dan Mané, Concrete Problems in AI Safety, arXiv:1606.06565 [cs.AI].

Victoria Groom and Clifford Nass, Can robots be teammates?, in Psychological Benchmarks of Human-Robot Interactions edited by Peter Kahn and Karl MacDorman, 2007, pp 483-500.

Elizabeth Kathleen Phillips, Kristin Schaefer, Deborah R. Billings, Florian Jentsch, Peter A. Hancock, Human-Animal Teams as an Analog for Future Human-Robot Teams: Influencing Design and Fostering Trust, Journal of Human-Robot Interaction, Vol. 5, No. 1, 2016.

Kristin E. Schaefer, Jessie Y. C. Chen, James L. Szalma, P. A. Hancock, A Meta-Analysis of Factors Influencing the Development of Trust in Automation: Implications for Understanding Autonomy in Future Systems, Journal of the Human Factors and Ergonomics Society, Volume 58, Issue 3, pp. 377-400, March 2016.