Project: Novel Haptic System and Experimental Study

The purpose of this assignment is for you to plan and execute a haptics project that provides a new contribution to the field of haptics. The project must result in a system with bidirectional haptic interaction between a person and a robot/intelligent agent or a augmented, remote, or virtual environment, as well as an experimental study that aims to show something new about human perception, answer a question about haptic device design, or demonstrate that your haptic device design is useful for some purpose. Beyond that, the options are quite open. Your project must:

- be clear in its objectives: know how you define success!
- be informed by a thorough literature search
- be easily used and understood by a haptics novice on demonstration day
- have high “production values” (haptic especially, and also visual)
- use the system in a compelling experimental study

Teams

The project is to be completed in teams of three. (Teams of three are desired for a smaller overall number of teams, to allow the teaching staff to devote more time and resources to each project. However, teams of two may be permitted with a compelling rationale.) All team members will receive the same grade for the project. We encourage project teams consisting of people with diverse backgrounds and skills.

Project Team and Initial Ideas

As part of Assignment 5, you will identify your team and do an initial brainstorm to identify possible haptic device designs and corresponding user studies. This due Friday, February 16 at 4:30 pm in the box folder of one of the team members. You will get feedback about your team and ideas, and then write the proposal.

After the teaching staff gets information about your Project Team and Initial Ideas, we will schedule a meeting with your team during February 20-22 to discuss your project plans. Together with the teaching staff, you will devise a set of checkpoints, i.e. milestones you need to have accomplished on each of the checkpoint dates listed below. The checkpoints will be included in your project proposal.

- Proposal due: Friday, February 23
- Checkpoint 1: Friday, March 2
- Checkpoint 2: Friday, March 9
- Demonstration: Thursday, March 15 (during class time)
- Experiment and final paper due: Tuesday, March 20

Project Proposal

Your proposal is due on Friday, February 23 at 4:30 pm in the box folder of one of the team members. Your proposal should be typed and easy to understand. The proposal should address the following questions and requirements, in this order:

- **Team Members and Skills**: Who is on your proposed team? What specific skills and knowledge does each person contribute to the team in the context of this project?

- **Topic and Motivation**: What haptic device design/implementation and user study will you perform? Why have you chosen this?

- **Previous Work**: Do a search for publications (conference papers, journal articles, and book chapters)
and media reports that are relevant to your proposed project. Pick five or more of the most relevant, recent sources. For each chosen source, provide the following information:

**The formal citation and a URL link to the publication.** At a minimum, this should include author names, title, source (proceedings, journal, or book), page numbers, and year. See the style used to list readings on [http://me327.stanford.edu](http://me327.stanford.edu). Also provide a direct link (URL) to the online resources.

**A summary of what the previous work reports.** This must be in your own words, not copied from the paper, and it should be thorough. You will need to read the paper entirely to understand what it deals with. Talk with your teammates and the teaching staff to figure out confusing aspects. You may wish to divide up the papers between your team members to distribute the workload, but you should all read and discuss the summaries you write. Be sure to state of what implications this paper has for your project.

**Identify a paper for presentation in class.** You will select this paper from the set of papers presented orally at the 2016 IEEE Haptics Symposium Conference or 2017 IEEE World Haptics Conference. This can be one of your 5 papers above, or you can add a 6th paper if necessary. Note that your presentation (10% of total grade) will be evaluated on organization, subject knowledge, slides, presentation skills, and interactivity. The teaching staff will review your proposed paper for presentation and assign you a presentation date.

- **Plan (1 page):** Describe what your team proposes to do. What do you seek to design or discover over the course of your project? This should be carefully thought out and clear. It should be a rational, clever, novel plan that has a good chance of success and does not repeat prior work. Include a description of what materials and resources you think you will need. Sketches will be helpful. Also include the checkpoints worked out in advance with the teaching staff.

**Materials and Fabrication Resources**

You are for the most part expected to purchase the materials needed for your project on your own, with the exception of (1) expensive items that could be purchased by or borrowed from Allison's lab if they can be re-used and (2) specific materials that have been purchased for the ME 327 class. For example, we have a variety of motors from Maxon, and you have your Hapkit components. During the initial project meeting we will review what materials you will need and discuss costs. You can work on your project in PRL (room 36 is recommended) and 520-145. We recommend that you store your project materials in 520-145 and keep them in a box that is clearly labeled.

**Demonstrate your Project**

We will have a Haptics Open House on Thursday, March 15 in 520-145. You will want to reserve some time before the open house to set up, as well as afterward to clean up and return your materials to the lab. At the demonstration, you will:

- Demonstrate and explain your project to the teaching staff for the functionality portion of the project grade. (The teaching staff can look at your demonstration on a previous day, if desired.)
- Create and hand out a flyer that gives the title of your project, your names, and an overview of the project.
- Allow visitors to try out your simulation/haptic device, while you explain your project and answer questions.
Run an Experimental Study

Your study should include enough repetitions (and possibly subjects if it is a user study) to enable statistical analysis, with the hope of obtaining significant results. We anticipate that most groups will run their study during the week of the open house (demonstration). The teaching staff will be available to provide guidance on experimental procedures, data analysis, and presentation of results in the paper.

Create a Final Report

To properly document your project, you will create a final report that is in the form of a complete, professional 4-6 page research paper. This report is due Tuesday, March 20 at 4:30 pm in the box folder of one of the team members. Use what you have learned from reading the literature to understand the style and content of a paper, and discuss your outline/content/writing with the instructors as needed. We are happy to provide feedback early and often.

The final report should:

- Be 4 to 6 pages in length.
- Be written as if you are going to submit it to a conference. (You should use formal writing; look at the papers we have read in class as examples.)
- Have a title, abstract, author list (with affiliations), and sections such as Introduction, Background, Design, Methods, Results, Discussion, Conclusion, Acknowledgments, and References.
- Contain sufficient motivation in the introduction to justify the work.
- Include at least 5 references in the background/previous work section.
- Contain a detailed description of the project, such that another student from the class could re-create your project/experiment from the report if necessary. The device design is part of the methods. Code and drawings can be included as an appendix (beyond the 4-6 page limit).
- Describe the results, which must include quantitative data and may also include qualitative responses, from the user study. You may wish to record qualitative responses and/or quantitative performance of users during the open house.
- Contain a conclusions/future work section describing how, based on your results, the system could be it can be improved, as well as how it might be applied.

We will provide Latex and Word templates so you can format the report like a ready-to-publish paper.

Grading

General
- Concept 15 pts. Is the motivation good, and the general idea logical?
- Approach 15 pts. Is the approach the right one to solve the problem?

Demonstration and User Study
- Functionality 20 pts. Did the system function compellingly throughout the demonstration?
- Completeness 15 pts. Was the working system and user study complete, compared to what proposed?

Paper
- Technical strength 20 pts. Is the paper technically accurate and complete?
- Presentation 15 pts. Is it well written, with appropriate supporting graphics?

TOTAL 100 pts.

These scores will take into account the difficulty of the project tackled. That said, we prefer that you aim to do a simple thing very well instead of trying to do a complicated thing and not succeed. Note that the project is 50% of the overall course grade.