ME218a Smart Product Design

ME 218a Fall 2011 Project
As Almost Seen On TV

Project Presentations on November 30, 2011 starting at 10am
Public Session begins at 7:00pm

Goals:

To produce a new interactive interpretation of either a mythical product or the sales pitch for a mythical product that might be seen in a commercial on late night TV (Think: Bass-O-Matic or Slap Chop or ShamWow, Chia Pet).

The projects will be viewed and enjoyed not only by your fellow ME218 students, but also by a throng of interested people (including children, 218 alumni and random people off the street) who may know little of the technology involved. Your design should be suitable and appropriate for viewing by a throng of interested people of all ages.

The machines will be displayed and demonstrated on tables in the Bldg. 550 Atrium. Keep this in mind when designing your machine.

Purpose:

The underlying purpose of this project is to give you some experience building an electro-mechanical widget. We expect that this will involve working with sensors, driving actuators, designing event driven software and implementing that software in C on the C32 Board. These are the elements that we expect to see in every solution.

Your lab kit contains sensors, signal and power transistors, although you are not limited to using only the parts in your kits. You are, however, limited to an expenditure of **$150.00/ team** of three for all materials and parts used in the construction of your project. Materials from the lab kit or the Cabinet Of Freedom do not count against the limit; all other items count at their Fair Market Value.

On the night of the presentations:

The Machines Almost Seen On TV (MASOTs) will be presented in the Atrium of Bldg. 550 (our classroom building). They will be distributed around the Atrium and the space leading to the glass garage door. The guests will wander around the room visiting the various MASOTs and experiencing the different teams' interpretation of what might have been Almost Seen On TV. You should strive to make the experience an exciting, active, electro-mechanical one.

Specifications

MASOT Operation:

- ☐ The operation of your MASOT will be initiated by an optical signal produced by an SPDL-supplied module. You will trigger the module to produce the optical signal by grounding a pin in a manner of your own choosing. Your MASOT will be required to detect the optical signal to start its operation. The module must be functional at a minimum of 12" away from the detector. The module may be re-packaged and extend outside the envelope defined below.
- ☐ Products are no good without people so your MASOT should not progress without continued interaction with the user.
- ☐ The average user should take approximately 30 seconds to interact with your MASOT. No one should be able to complete the process in less than 20 seconds.
- ☐ In the event that the user is unable to complete the interaction process within 45 seconds, the MASOT should stop interacting with the user and indicate that it is ready for a new user.
- ☐ Your MASOT's interaction with the user should involve at least 3 distinct user interactions.
- ☐ The process of interacting with your MASOT should result in at least 4 distinct outcomes.
- ☐ Your MASOT should require large scale motion on the part of the user for at least one of its interactions.
- ☐ At least 2 of the interactions with the user must produce different outcomes based on the state of the MASOT.
- ☐ Each MASOT should include a creative display of the passage of time. No 7-segment displays.
- ☐ Each MASOT should include an indication of when it is active (and therefore responsive to interactions) and when it is dormant.

- ☐ When the user completes the interaction, the MASOT should provide an exciting audio and/or visual experience that will inspire hope, or fear or apathy or paranoia, or …
- ☐ The MASOT may optionally be designed to support or require the collaboration of two users in the operation of a single MASOT.
- ☐ The MASOT must be usable without human instruction. Any static instructions must be only in pictorial form (e.g. Ikea assembly instructions).

Basic Specifications:

- ☐ A team of three class members will construct each MASOT.
- ☐ Each MASOT must have parts that visibly move under the control of the machine.
- ☐ Each team must construct a MASOT. While it is permissible to use consumer devices as components, such devices must be substantially modified before incorporation into your project. I don't want you to just buy significant portions of your project. If there is any question as to whether or not the purchased component has been modified significantly enough, please see the teaching staff.
- ☐ Each MASOT must respond to at least three distinct inputs/interactions.
- ☐ At least one of the user interactions must be interpreted as an analog input from the user.
- ☐ At least one of the user interactions must involve non-contact sensing.
- ☐ Each MASOT must provide the user with feedback about his/her actions. The feedback must include at least one of: haptic/audio/tactile feedback. Multiple modes of feedback, including modes not listed here, are encouraged.
- ☐ The complete MASOT must be a self contained entity, capable of meeting all specifications while connected only to the project power supply that will be provided.
- ☐ In order to qualify for free shipping, the MASOT **MUST** fit into a footprint no more than 18" wide by 18" deep by 36" high. During operation, the user interaction may occupy no more than an 18" wide x 18" deep x 80" high volume in front of the MASOT. Two MASOTs must both be usable while sitting together on one of the 5' wide tables in our classroom. The entire MASOT must be easily and safely moved from the construction site to the grading session and then again to the Atrium for the presentations. Make sure that you plan for this.
- ☐ The emphasis in the project is on *robust* electronics, software and mechanical systems built with *real craftsmanship*. Paint alone does not add to either functionality or craftsmanship. This is not to say that you may not decorate the machine, simply that it should not become a focus. Any painting that is done near the SPDL must be done using appropriate masking so that **no** paint residue is left on the building or furniture. **No Painting in the SPDL!**
- ☐ While it is normally not a good practice, the finished circuitry may be constructed on your proto-board. This has been done to allow you the maximum time to spend on your project, without having to learn electronic prototyping techniques as well. Be sure to secure the proto-board and connections so that they will not be disturbed by the moving process.
- ☐ Accurate schematics are such a useful aid in debugging that you should be prepared to show your up-to-date schematic to any coach or TA when you ask them for help on your project.

Safety & Hygiene:

- ☐ The MASOTs must be safe for both users and spectators.
- ☐ Be considerate of your neighbors in the lab when debugging any audio output; use headphones.

- ☐ No toxic materials. This prohibition includes Volatile Organic Compounds (VOCs) (i.e. hydrocarbon based spray paints or other noxious fumes). **This prohibition also includes while you are working on the exhibit in the SPDL.**
- ☐ **No Painting in the SPDL!**
- ☐ No part of the MASOT may become ballistic outside the 18"x18"x36" size envelope outlined above.
- ☐ No pyrotechnics or fire of any kind!
- ☐ If the MASOT contains any liquids, they may not be conductive (with the exception of water) or corrosive, and **MUST** be packaged in a fail-safe manner.

Check-Points

Design Review:

During the evening of November 9th between 8 & 11pm in **Braun Auditorium** we will conduct a design review. Each group should prepare a few **simple** Powerpoint slides (4:3 format, .ppt **not** .pptx format)(scans of sketches are OK) showing your ideas, a preliminary event list, with responses and a list of how you are going to meet the user interface requirements. No code, no state diagrams, no circuits. The presentation files must be in the "presentations" folder on the server by 8pm. You will present these to the class, members of the teaching staff and coaches so that all may hear about your ideas and provide feedback and advice. **At this time you will be required to identify the core functionality of your proposed design and how it meets the interaction requirements.**

First Check-Point:

On 11/11/11, you must submit a schematic of at least the core functionality initially identified on 11/09 and a refined set of events with details on the responses. Modifications to the core functionality may take place up to this point. A Protel schematic plus a word document describing your core functionality should be left in your "Reports" folder. We'll sweep your "Reports" folder at 5pm. Only one team member needs to submit your check-point documentation.

Second Check-Point:

On 11/17/11 you will be required to demonstrate a minimal level of function:
The hardware & software necessary to sense inputs, make decisions based on the inputs and implement the electro-mechanical response. Submission of a Protel schematic of your circuit will also be required.

Third Check-Point:

On 11/28/11 you will be required to demonstrate integrated functionality of all sensing inputs, plus software and timing, plus activating all actuators that will be required.

Grading Session:

On 11/30/11 you will be required to demonstrate your fully integrated and finished machine.

Report:

Draft due on 12/05/11 at 4:00pm. Final version with revisions due by 5:00pm on 12/09/11.

Evaluation

Performance Testing Procedures:

All machines will be tested by a demonstration performed by a team member that should show all of the possible user interactions.

Grading Session Presentation:

Each team should prepare a **30 Sec.** (no more) presentation to introduce the machine. This presentation should highlight the unique features of the design, not the circuit details. As an example, think back to the xylophone descriptions that were played on the first day of class. You will be setting up your machines, one at a time, and delivering your presentation in room 202 Thornton between 10am & 6:00pm on the day of the presentations. During this time each team and their machine will be photographed. Starting at 5:00pm you will move your machines into the Atrium for the public presentation, which will begin at 7:00pm.

Grading Criteria:

- ☐ **Concept (20%)** This will be based on the technical merit of the design for the machine. Included in this grade will be evaluation of the appropriateness of the solution, as well as innovative hardware, software and use of physical principles in the solution.
- ☐ **Implementation (20%)** This will be based on the prototype displayed at the evaluation session. Included in this grade will be evaluation of the physical appearance of the prototype and quality of construction. We will concentrate heavily on the craftsmanship exhibited by the final product.
- ☐ **Performance (40%)** Half of this (20%) will be based on the results of the Check-points, the other half will be based on the results of the performance testing during the evaluation session. Full performance credit will be given only if the machine works on the first attempt during the grading session. Performance will be judged first on the ability to demonstrate the core functionality and second on any embellishments to the core functionality. **To earn the Performance points, you must demonstrate at least the core functionality.**
- ☐ **Report (10%)** Preliminary project reports are due December 5, 2011 at 4:00pm. The report should be in the form of a stand-alone web site and must include schematics, pseudo-code, header & code listings, dimensioned sketches/drawings showing relative scale, a complete Bill-of-Materials (BOM) for the project as well as a 1 page description of function and a "Gems of Wisdom for future generations of 218ers" page. The web-site must be submitted as a single **Zip** file (7-zip is installed on all the workstations in the lab). It is critical that your report be in the Reports folder on time so that the peer reviewing team will have an adequate opportunity to review it before class the following day. Final versions of the reports, incorporating the review comments are due (also in the form of a single zip file) by 5:00pm on 12/09/11. The front page of your project description must be in a file called `index.html` at the root folder of the web site. Test your zip-file by unzipping it into an empty folder. Once unzipped, you should be able to view the entire site starting from the `index.html` file.
- ☐ **Report Review (10%)** These points will be awarded based on the thoroughness of your review of your partner team's report. Read the explanations, do they make sense? Review the circuits, do they look like they should work? Could this MASOT realistically be built for $150? If, during grading, we find things that don't make sense or circuits that won't work we will consult your review. If the review caught them, then the team will lose points on their report. If the reviewers missed it, then they will lose points for their review. The report review should submitted be in the form of a word document that you place into one of your team members folders by 4pm on 12/06/11.

Suggestions

We understand that the project definition is probably a bit more open than you might be used to. To help you get your creative juices flowing we offer some reflections that you might want to consider.

- ☐ Don't just think buttons. Think about novel ways to sense an action and give feedback. Remember, you have more than just fingers available to actuate and you are mechanical engineers (at least most of you). Think fun linkages!
- ☐ **The Tao of 218:** Simplicity Leads to Reliability. We are extremely skeptical of the need for more than one of your proto-boards to hold the finished circuitry. Remember, you only have 456 hours available to complete the project (and tend to the other things in your life) before it is due.

Resources

- ☐ `www.sparkfun.com` `www.adafruit.com`
  `www.seeedstudio.com` `www.hackaday.com`
  `www.jameco.com` `www.digikey.com`
  `www.mouser.com` `www.mcmaster.com`
  `www.newark.com` `www.hobbyking.com`
  `www.ponoko.com` `www.servocity.com`
- ☐ J&M Hobby House in San Carlos
  Jameco in Belmont
  TAP Plastics in Mountain View

Exercise your creativity:

We encourage, and hope to foster, a wide range of solutions to the problem. This will make for the most enjoyable presentation for your audience. There is no 'Best' way to solve this problem, so don't spend time looking for it. While brainstorming, think about how you might pantomime your favorite crazy commercials.

Remember that we interact with electronic devices every day. People tend to have more fun with projects that don't try to emulate the look and feel of actual products. ME218 is an opportunity to design things that are fun and whimsical. Take advantage of that.

Make your machine robust:

Your machine must be rugged enough to survive your testing as well as 'testing' by the audience. Don't be timid about playing with your project before the presentation. Play with it as if you didn't know its weaknesses. Let your friends play with it. Find out if it can survive people playing with it *before* the presentation.

While the emphasis in the lecture has concentrated on the electronics, don't forget the mechanical aspect. Historically, machine failures are often due to poor mechanical design or implementation. Pay attention to craftsmanship. It will pay dividends in many ways.

Gems of Wisdom from Past Generations

Will be available on the SPDL Web site. Be sure to check them out for guidance from past generations.