ME218a Smart Product Design

ME 218a Fall 2008 Project: Ancient Technology And Ridiculous Interactions

Project Presentations on November 19, 2008 starting at Noon
Public Session begins at 7:00pm

Goals:

To produce a new electro-mechanical interface to a vintage computer game that will provide an engaging and entertaining experience for a player and an appreciative audience.

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. You should keep this in mind when designing a project suitable for viewing by all ages.

The machines will be displayed and demonstrated on the tables in 556. 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 might be able to construct the electro-mechanical parts of this project using only the parts in your kits, you are not limited to this. 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.

Setting the Scene:

On the night of the presentations, the vintage computer game consoles and TV monitors will be arranged around the room in Terman 556 (our classroom). The guests will wander around the room visiting the various consoles and playing one or more of the vintage computer games. You should strive to make the experience an exciting, active, electro-mechanical experience.

Specifications

Basic:

- ☐ The Vintage Controller Replacement (VCR) that your team builds will plug into the game console protection board in place of one game controller on an Atari Flashback II video game console. The VCR must interface to the game console in the same manner as the original controller.
- ☐ The complete VCR must be a self contained entity, capable of meeting all specifications while connected only to the project power supply that will be provided and the game console.
- ☐ A team of three class members will construct each VCR.
- ☐ The team must construct the VCR. 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.
- ☐ Each VCR must include at least one analog input from the player.
- ☐ At least one of the player interactions must involve non-contact sensing.
- ☐ Each VCR must provide the player with feedback about their 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 feedback should be based on **player** actions, not the state of the game (which you have no way of knowing).
- ☐ Each VCR must provide a replacement for all of the controls available on a stock controller.
- ☐ Interactions with the VCR need not be associated 1:1 with button presses on the Atari. For example, could have a steering wheel that gives quicker simulated button presses the further you turn it.
- ☐ A VCR may include a component that interacts with the opposing player on the game console.

- ☐ While your VCR must work with all of the games, you are encouraged to thematically associate your VCR with a game or class of games.
- ☐ The game console protection board will provide a signal (Console Power Status) that will be at 3.3 V when ever the game console is turned on. The pinout for the connection to the game console protection board will be:

  1: Up, 2: Down, 3: Right, 4: Left, 5: Button, 6: Ground, 7: Console Power Status, 8: No Connect
- ☐ You may connect anything directly to the game console. All connections will be through the game console protection board.
- ☐ The VCR may optionally be designed to support or require the collaboration of two players in the control of a single VCR.
- ☐ Your team may partner with another team so as to present a thematically coordinated set of controllers.
- ☐ Each VCR must implement a "Cheat Code", see section below.
- ☐ The entire operation of the VCR and player **MUST** take place in a footprint no more than 5 feet wide by 5 feet deep by 8 feet high. The VCR must collapse (or initially fit) into a volume of no more than 3'x3'x2'. The tables in 556 will be available to hold the VCR if required. The entire VCR must be easily and safely moved from the construction site to the grading session and then again up to 556 for the presentations. Make sure that you plan for this.
- ☐ Your VCR must be usable without human instruction. Think about how you could convey how to interact with the VCR without a list of instructions.
- ☐ 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 outside the SPDL must be done using appropriate masking so that **no** paint residue is left on the building or furniture.
- ☐ 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.

The Cheat Code:

Video games often include "cheat codes" that enable some extra feature or add extra powers to a player. While we do not expect you to hack the video games to provide these features, we will require that your VCR include a cheat code that enables some cool electro-mechanical feature of your VCR.

- ☐ Enabling the cheat code must be a multi-step (at least 3) process.
- ☐ The enabling process must include some timing constraints on the necessary steps (i.e. wait at least 1 but no more than 3 seconds between steps 1 and 2). Failing to meet the constraints should result in restarting the sequence.
- ☐ Once enabled, the cheat code must create an electro-mechanical output in response to a player's actions.
- ☐ Any description of how to enable the cheat code may not involve the use of language.
- ☐ Your VCR must sense the power-on state of the game console and reset the cheat code when the power to the console is turned off.

Safety & Hygiene:

- ☐ The VCRs 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 also includes while you are working on the exhibit in the SPDL.
- ☐ **No Painting in SPDL!**
- ☐ No part of the VCR may become ballistic outside the 5'x5'x8' size envelope outlined above.
- ☐ No pyrotechnics or fire of any kind!
- ☐ If the VCR 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 5th between 7 & 10pm we will conduct a design review. Each group should prepare a few sheets of paper showing your idea(s) and a preliminary software design. You will pin these up to the walls in 556 and members of the teaching staff and coaches will come around to 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.**

First Check-Point:

On 11/07/08 you must demonstrate the ability to simulate all 5 inputs to the game console. You must also submit a schematic of at least the core functionality initially identified on 11/05. 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 11/11/08 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 to the cheat code. Submission of a Protel schematic of your circuit will also be required.

Third Check-Point:

On 11/17/08 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 11/19/08 you will be required to demonstrate your fully integrated and finished machine.

Report:

Draft due on 12/01/08 at 4:00pm. Final version with revisions due by 5:00pm on 12/05/08.

Evaluation

Performance Testing Procedures:

All machines will be tested by a demonstration performed by a team member that should show all of the possible game interactions as well as the VCR Cheat Code behavior.

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 203 Thornton between Noon & 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 room 556 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 1, 2006 at 4:00pm. The report should include schematics, pseudo-code, header & code listings, dimensioned sketches/drawings showing relative scale, a complete Bill-of-Materials (BOM) for the project and a 1 page description of function. 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 by 5:00pm on 12/05/08
- ☐ **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 VCR realistically be built for $150?

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.

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 buildings, sports, holidays, food, entertainment, culture, travel, shopping, climate and animals define a location.

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 of other electronic devices. 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.