ME218a Smart Product Design

ME 218a Fall 2009 Project: FLICKER

Fast, Laughable, Interactive, Computerized, Kitsch using Electromechanical Robots

Project Presentations on November 18, 2009 starting at Noon

Public Session begins at 7:00pm

Goals:

To produce a new interactive electro-mechanical depiction (FLICK) of an easily recognizable visual scene (e.g. from a movie, play, TV show, comic, picture book…) 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.

On the night of the presentations:

The FLICKERs will be arranged in sets of 5 or 6. They will be distributed around the room in Terman 556 (our classroom). The FLICKERs within the sets will be interconnected to form a relay race from the first machine to the last machine. The guests will wander around the room visiting the various FLICKERs and playing one or more of them. You should strive to make the experience an exciting, active, electro-mechanical experience.

Specifications

FLICKER Operation:

- ☐ The scene being depicted should not progress without interaction from the user.
- ☐ The average user should take approximately 30 seconds to move the scene from start to finish. No one should be able to complete the scene in less than 20 seconds.
- ☐ In the event that the user is unable to complete moving the scene from start to finish within 45 seconds, the FLICKER should stop interacting with the user and automatically trigger the next machine in the chain.
- ☐ Moving the scene from start to finish should involve at least 3 distinct sequential user interactions.
- ☐ Each FLICKER must be capable of being initially triggered by another FLICKER and at the end of the interaction must provide the trigger for the next FLICKER in the chain.
- ☐ Each FLICKER must have a button that forces the FLICKER to become active, allowing it to be the first FLICKER in the chain. This button should be placed on the left hand side (as viewed from the front) of the FLICKER.
- ☐ Each FLICKER should include a creative display of the passage of time. No digital clocks.
- ☐ Each FLICKER should include an indication of when it is active (and the interactions therefore possible) and when it is dormant.
- ☐ When the user completes the scene, the FLICKER should provide an exciting audio-visual indication of success and trigger the next machine in the chain.
- ☐ In the event that the 45 second time limit expires without the user successfully completing the scene, the display of success should not be activated.

- ☐ The FLICKER may optionally be designed to support or require the collaboration of two players in the control of a single FLICKER.

  To orient your users you may include a maximum 200 word plot synopsis. However, the FLICKER itself must be usable without human instruction. Any static instructions must be only in pictorial form (e.g. Ikea assembly instructions).

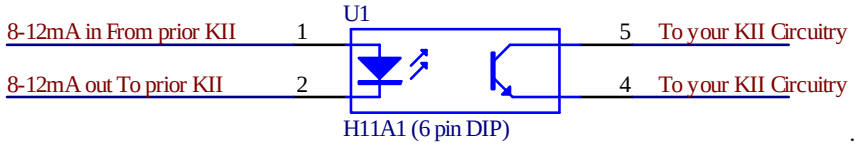
Basic Specifications:

- ☐ A team of three class members will construct each FLICKER.
- ☐ The team must construct the FLICKER. 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 FLICKER must include at least three distinct inputs/interactions, one of which must involve analog input from the player.
- ☐ At least one of the player interactions must involve non-contact sensing.
- ☐ Each FLICKER 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 scene.
- ☐ The complete FLICKER must be a self contained entity, capable of meeting all specifications while connected only to the project power supply that will be provided and to the adjacent FLICKER(s).
- ☐ The entire operation of the FLICKER and player **MUST** take place in a footprint no more than 3 feet wide by 2 feet deep by 4 feet high. The FLICKER must sit on one of the tables in Terman 556. The entire FLICKER 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.
- ☐ 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.

The Connections between FLICKERs:

In order to improve the robustness of the connections between FLICKERs we are requiring that the triggering mechanism between the FLICKERs be through an optical isolator.

- ☐ The triggering machine must provide a current flow of at least 8 mA and no more than 12 mA through the LED of the opto-isolator.
- ☐ Each FLICKER will have an input side and an output side. The opto-isolator will be on the input side of each FLICKER. The input connector will be located on the left hand side (viewed from the front) of the FLICKER. The output connector will be located on the right hand side.

- ☐ The standard opto-isolator will be the H11A1. Each FLICKER will be required to use this opto-isolator.
- ☐ 

- ☐ Connection between FLICKERs will be via 6-pin RJ-11 connectors. Two standard connectors will be provided to each team. The **RED** wire on the connector will be connected to the LED **anode** and the **YELLOW** wire will be connected to the LED **cathode**.
- ☐ Each team must construct a straight-thru pin-out cable to connect between the FLICKERs. The cable should be 10' long.
- ☐ The trigger pulse must cause current to flow in the LED of the opto-isolator for at least 50ms and no more than 100ms.

Safety & Hygiene:

- ☐ The FLICKERs 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 FLICKER may become ballistic outside the 3'x2'x4' size envelope outlined above.
- ☐ No pyrotechnics or fire of any kind!
- ☐ If the FLICKER 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 4th between 7 & 10pm in **Bldg. 380 Rm 380c** we will conduct a design review. Each group should prepare a few **simple** Powerpoint slides (scans of sketches are OK) showing your ideas and a preliminary event list, with responses. 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.**

First Check-Point:

On 11/06/09, you must submit a schematic of at least the core functionality initially identified on 11/04 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 11/10/09 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 11/16/09 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 11/18/09 you will be required to demonstrate your fully integrated and finished machine.

Report:

Draft due on 11/30/09 at 4:00pm. Final version with revisions due by 5:00pm on 12/04/09.

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 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 November 30, 2009 at 4:00pm. The report should be in the form of a 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 12/04/09. 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 un-zipped, 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 FLICKER 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 12/1/09.

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 you might pantomime your favorite scenes.

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.