FINAL PROJECT - A COIN-OPERATED MECHATRONIC ARCADE GAME

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FEBRUARY 27, 2018

1 *Goal*

The goal of your final project is to design and build a tabletop, coin-operated mechatronic arcade game that provides a compelling gameplay experience for all players. The final version of your game will debut in the Elecanisms Penny Arcade at Expo at the end of the semester and must be playable by any and all Expo attendees.

2 *Purpose*

The purpose of the final project is to provide you with a realistic experience working in teams to design and implement a reasonably complex electro-mechanical system based on the PIC24 microcontroller board we've provided. Your system design and execution will be driven by creating compelling player interaction and will have to balance complexity, robustness, and degree of "polish."

Each team will consist of four or five team members, and every team will be provided with a nominal budget of $300 (see requirement 9). Materials provided as part of the miniprojects (eg. PIC24 board, motor shield, etc.) are not counted against that budget. Teams may spend more than $300 (or use more than $300 worth of materials), but we can only reimburse up to $300 from the course budget. The costs of materials acquired by means other than purchase (eg. salvaged, repurposed, gifted, etc.) should be included in estimates of total project cost, but do not count against the $300 budget.

The following are the objectives of the project:

1. Provide experience interfacing with different sensors and actuators
2. Develop electro-mechanical integration and hardware/firmware debugging skills
3. Encourage creative approaches to gameplay and user interaction
4. Design, develop, and test an integrated product from start to finish

3 *Requirements*

The emphasis in this project is on robust design in all domains, mechanical, electrical, and software/firmware. Based on our past experience, the most likely source of failure will be in mechanical design. Accordingly, simplicity and an attention to crafstmanship will pay dividends.

The following is a list of requirements for all project teams

1. Each game should be devised and created in the spirit of a penny arcade game. The goal is to provide a compelling experience for the player. Concepts for traditional penny arcade games range from pinball and skeeball, to feats of strength, hand-eye coordination challenges, and even fortune-telling.
2. Gameplay begins with the insertion of a standard U.S. penny.
3. Your game should provide a visible measure of how well a player has done (you may optionally dispense rewards to players on the basis of their performance).
4. Your game should provide a player interaction that lasts anywhere from 30 seconds to 2 minutes.
5. The time to play your game should be limited, and your game must provide a clear indication of when time has expired.
6. Your games must be standalone entities, powered from an integrated power supply (ie. not a standard benchtop supply like you might find in the ECE stockroom.)
7. You may incorporate existing consumer devices, but they must be substantially modified.
8. You may incorporate additional computing resources, but a significant portion of your electromechanical system should rely on the PIC24 board you have used for your miniprojects.
9. Your game must fit within a volume of 72 ft^3, and the sum of the linear dimensions of the bounding box must be less than 13ft. **Bonus: We will increase your team's budget by $3 for each inch under 156 (the number of inches in 13 feet) the sum of the linear dimensions of your bounding box is.**

$$\text{Total Budget} = \$300 + \$3 \times (156\text{in.} - (L_b + W_b + H_b)) \quad (1)$$

10. It must be possible to understand how to play your game without human instruction.

11. The final version of your game may not include any solderless breadboards (though, prototyping with them is acceptable).
12. No part of your game may become ballistic outside of the table-top dimensions, and all powered/actuated components must remain attached to or in contact with your game assembly.
13. Your game must be safe for both players and spectators.

4 *Sources of Inspiration*

There are many, many ways to design and construct an interesting game that meets all of the requirements. When brainstorming, we encourage you to think about the elements of games you enjoy or know others find engaging. For inspiration and more insight into what a penny arcade game is (or could be in this context), we've provided a few resources below.

- San Francisco's Musee Mechanique
- Marvin's Marvelous Mechanical Museum
- Suffolk, UK's "Under the Pier Show", building coin-operated machines.
- Projects from past offerings of this course
- Past projects from Stanford's ME218a course, "Smart Product Design"
- Bop It is a simple, but interesting, handheld mechatronic game.
- Most useless machine - A great game waiting to happen with the right gameplay interactions.
- Most useless box with attitude - An excellent demonstration of how to give a machine personality.

5 *Project Structure & Timeline*

This project is eight weeks long and will be structured in a series of four two-week-long sprints. Sprints are intended to be focused periods of work, the result of which is a system that is sufficiently integrated to demonstrate a working concept. **Every sprint review teams are required to publicly demonstrate an integrated product with components of mechanical and electrical design as well as integrated actuation, sensing, and computation.**

The intention behind this approach is to encourage teams to pursue *continuous integration* instead of focusing sequentially on subsystem design and leaving integration to the last minute. One consequence of this approach is that teams are frequently forced to reduce the scope of their projects. Because this course is an advanced elective, a well-executed project of limited scope is preferable to an ambitious project of questionable execution.

Sprint 1: February 27 - March 13
Sprint 2: March 13 - Arpil 3
Sprint 3: Arpil 3 - April 17
Sprint 4: April 17 - May 1
Demo Day: Monday, May 7, 12pm - 3pm
Expo: May 14

6 *Deliverables*

The deliverables at the end of every sprint will consist of a live demonstration of your integrated system by the team before the entire class accompanied by a short presentation. The feature set to be demonstrated by the team is determined at the beginning of the sprint in the sprint planning process. Each set of sprint deliverables will be graded on a standard letter scale and grades will be accompanied by written feedback. The grades for individual sprints are weighted by the length of the sprint in the calculation of final course grades (ie. a two week sprint represents $\frac{2}{13}$ of an individual's final grade).

The **final deliverable** for the course is a website with extensive documentation of the project. Websites will be hosted in a subdirectory of the course site (elecanisms.olin.edu), and details for the website requirements will be distributed as soon as teams have been formed.

7 *Teaming*

Each team should consist of either 4 or 5 members. We recommend attempting to strike a balance of skills covering mechanical engineering/design, electrical engineering, and software/firmware development. Teams for this project are self-selected.