EECS 373 Projects

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Due 13 Februrary 2024

1 Overview

This document explains project expectations and is relevant to your final project proposal due on 13 Februrary. For information on the availability of, and complexity of working with, components please write or speak with Matthew Smith or Robert Dick.

2 Safety

You must consider potential dangers inherent in your embedded system design and take appropriate precautions.

- Spinning Devices: High speed spinning devices must be contained so that in the event that they fail that they do not throw objects and slice/rupture eyes. You may also be required to wear safety glasses when operating this sort of equipment.
- Consumable Foods: Projects that involve beverages or food must be isolated from toxic substances such as lead and toxic adhesives.
- Alcoholic Beverages: University Policy Prohibits use of alcoholic beverages on University Property including non-alcoholic beers.
- Projectiles: Projects involving projectiles must use soft materials and/or safe velocities. Some form of containment might be required.
- Heat: Projects involving heat may require some form of insulation or isolation. High heat levels that can cause combustion will not be allowed.
- High Voltage: Projects requiring voltages like the line current from AC outlets must us special isolation devices available in the lab.
- Lasers: Project using lasers must provide containment or shielding to prevent light from reflecting and potentially damaging eyes.
- Batteries: Be careful not to short batteries, which can burn or melt components. If your project requires lithium ion batteries, speak with Matthew and Robert.

Potentially unsafe project components require staff approval. Speak with lab staff if your project will require substantial space. We need to verify that it won't undermine safety or lab use.

3 Project Grade Weights

The grading scheme is described in detail, below. It can be summarized as follows. Use sensors, actuators, displays, FPGAs, and microcontrollers with enough complexity to satisfy the complexity requirement. Once the complexity requirement is met, make the entire project as useful, cohesive, impressive, and reliable as possible.

Category	Maximum value	Typical value for good project
Base requirements	5%	5%
Complexity requirement	40%	40%
System integration / cohesivenes / reliability	15%	8%
Usefulness / novelty	10%	3%
Extraordinary technical achievements	5%	0%
Proposal	7%	5%
Project cleanup	5%	5%
Poster, pitch, and demo	10%	7%
Report and documentation	3%	2%
Total	100%	75%

3.1 Base requirement

Your project or application should demonstrate your laboratory skills with at least 3 of the primary lab topics.

1. Bus Interfacing (APB3 or serial device such as SPI or I2C).
2. ABI/Device Driver.
3. Interrupts.
4. General Purpose Timers (GPT).
5. Analog to Digital (ADC) or Digital to Analog (DAC) Conversion.

3.2 Complexity

For each person on your team, the project must have one complexity unit. The number of complexity units for the project is the sum of the complexity units for specific tasks, which are generally fractional. Several examples follow. You are welcome to use components not on this list and propose appropriate complexity points for them, using similar components in the table below as references.

Device	Complexity
Servo	1/4
Stepper motor	3/4
DC motors w. H-bridge	2/3
Solenoids	1/4
Electrical and optical isolation	1/3
Serial character display	1/2
Graphics display	2/3–1
Numeric keypad	2/3
Nintendo 8 controller	1/4
Nintendo 64 controller	1
IR distance sensor	1/4
Ultrasonic sensor	1/2
Force or flex sensor	1/2
Light sensor	1/4
XBEE	1/2
IMUs	1/3–2/3
Microphone	1/3
Complex use of FPGA	1/2–1
Other SPI/I^2C interface	1/4–1/2
Sophisticated device driver code	1/4–3/4

3.3 System Integration / Cohesiveness / Reliability

How well do the components in your system function, fit, and work together to solve the key problems it addresses? Avoid combining components in a way that doesn't improve the overall system. Does the system work as intended most of the time? We will forgive infrequent failures, but if your prototype fails most of the time, that is a problem. Questions to keep in mind follow.

- Are the components relevant to the application?
- Do the sensors support the application or are they superficial?
- Is display information relevant?
- Is component performance relevant and appropriate to the application?
- Appropriate sensor range/response?
- Appropriate actuator range/resolution?
- Appropriate display capacity/response?
- Is the application reliable and repeatable?
- Is it necessary to reset the entire system after each trial?
- Do mechanical parts fall off?
- Do connections break?
- Do components require physical adjustment after each trial?
- Do electrical components (potentiometers, etc) require adjustments between trials?
- Is system function appropriate for application?
- Is the system responsive?
- Functional ranges adequate?

The following grading scheme will be used.

- Components do not work well together. (0 points)
- Some components work together while others do not. (2 points)
- Most components work together. (5 points)
- All the components work together, but under some conditions the system has major failures. (8 points)
- All the components work together, but under some conditions the system has minor failures. (10 points)
- All components work together under reasonable application conditions seamlessly with no bugs or problems of any kind. (13 points)
- The system works well enough you would be satisfied buying it. It is responsive, fast, does something interesting, bug free, etc. (14 points)
- Works better than you would expect from a typical functional product. (15 points)

3.4 Usefullness / Novelty

Prototypes that demonstrate a clear path toward a product that would provide substantial value to those outside the class will receive usefullness points. Prototypes that demonstrate new design concepts or answer to previously unanswered questions will receive novelty points. Up to 10 points can be earned via usefulness, novelty, or a combination of the two.

3.5 Extraordinary Technical Achievements

Up to five points can be earned via deign heroics, e.g., ultra-fast and energy efficient signal processing algorithms implemented directly in hardware, integrating a new type of sensor of your own design, etc. Most projects won't earn these points, and it is possible to get a very good grade in the course without them.

3.6 Proposal

Proposals will be graded based on accuracy, clarity, level of detail, organization, and writing quality.

3.7 Project Clean Up

You are required to leave the lab as you found it, relatively clean. Part of this requirement is satisfied by breaking down your project at the end of the semester. If you purchase components and do not request reimbursement, you are welcome to keep them.

3.8 Poster, Pitch, and Demo

You will be responsible for preparing a poster, demonstrating your project publicly, and briefly explaining it in a clear and compelling way.

3.9 Report and Documentation

Code, schematics, and documentation must be submitted for the project. The final report can be viewed as an extended and refined version of the project proposal. Although only three points are allocated to this portion of your grade, good performance in this area can retroactively increase a proposal grade. It also influences several other components of your grade: if we don't understand the significance of your achievements, we may not accurately account for them when grading.

4 Component Sources

Many components are in stock, so check with Matthew before ordering. If you would like to be reimbursed, Matthew or Robert need to approve your order. The following sources are good. Feel free to use other sources.

- Jameco Inc.: http://www.jameco.com
- Digikey Inc.: http://www.digikey.com
- Acroname: http://www.acroname.com
- Spark Fun Electronics: http://www.sparkfun.com
- Images SI Inc.: http://www.imagesco.com
- Adafruit: http://adafruit.com

5 Final Comments

The project complexity points are a constraint, not an optimization objective. Once the constraint is met, all your remaining design effort should go into making the project work well and solve an important problem.

You are encouraged to discuss ideas with classmates. I will take effort to make sure that helping another do better will not undermine your own grade. Although I will honor the grade topic weightings indicated in the syllabus, I will fix set the course aggregate grade to letter grade mapping only at the very end of the course when it is clear how the class performed relative to typical. If the projects are better than typical for the course, there will be more A grades in total. If they are worse than typical, there will be fewer A grades in total. The right philosophy is, "I'll get my own work done, but I'll help others when time permits."