The EECS 1011 Hands-on Project

One sentence overview

Go beyond the labs and class material and demonstrate, via a hands-on project, how you have achieved proficiency.

Overview

Each student is responsible for creating a hands-on project based on the Grove board and MATLAB. Students are responsible for costs and materials related to the project.

Grade weighting

To possibly achieve a final grade of "above expectations" (A or A+) you will need to successfully complete a major project in this course. This work is completely optional and goes beyond the completion of the other material in the course.

The project is worth 20% of your final grade. Completing the major project will possibly lead to a change in your pre-project final grade, as per the following:

- Below Expectations (1/4) : no change to your pre-project grade.
- Marginally meeting expectations (2/4): increase by <u>one</u> increment (B to B+ and below, but <u>not</u> B+ to A.)
- Meeting expectations (3/4): increase by <u>one</u> increment (B to B+, B+ to A, etc.)
- Exceeding expectations (4/4): increase by <u>two</u> increments (B to A, B+ to A+, etc.)

Want to exceed expectations?

- Go <u>beyond</u> an excellent technical widget.
- Context and Impact of your widget
  - Social
  - Political
  - Environmental
- Researched
  - Citations to existing technologies, issues
  - Mix "popular" & "academic" sources (scholar.google.com; library.yorku.ca)
- Alternative
  - Excellent Technical Widget
  - Wikipedia entry in Embedded domain
    - Translation
    - Person profile (new; non-traditional)
    - Technical entry that addresses equity, diversity, inclusion issue

Each component of your project will be assessed against a four-point rubric. Each rubric is equally weighted. The average of them will determine your project grade.

Final Submission (20% of final grade)

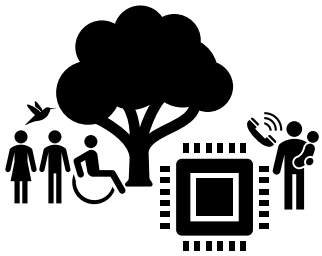
1. Five minute video (10% of final grade)
2. Five page report (10% of final grade)
3. Due on last day of class in December by 11:55pm.

You are permitted to submit it late. However, each day that the submission is late, a penalty of 5% final grade mark will be applied.

Project topic

The application or topic is up to you. It needs to be related to computational thinking, procedural programming, instrumentation and/or mechatronics. What you need to do is:

- Solve a problem with a computer system
- Design and implement the solution
  - Use a microcontroller (Grove board)
  - Use MATLAB
  - Integrate external components (like sensors, communication, motors and/or displays)
  - Program the board and MATLAB
  - Test the system
  - Demonstrate the system



No Re-use of other peoples' work

Any re-use of another person's project (in class, online or otherwise) will result in a grade of 0 on this project. The project must be original and must be executed by the student. Any help received by the student (online forum questions, etc.) needs to be cited, with a transcript in the appendix of the report (does not count towards the page count).

Yes, you may use pre-existing libraries and/or header files. However, if a significant portion of the project appears to be entirely based on this external work it will count as if the work were not original.

Project technical scope

The project's technical scope is variable, just as the topics are.

The general "rule of thumb" is:

1. Two simple sensors or one complex sensor (inputs)
2. Two simple or one complex actuator/display(outputs)

This assumes that the sensors or actuators are relatively "basic." Three of each might make sense, depending on your design. If you were using a very complex sensor, then only one would be sufficient.

Consider the following:

- Your experience level dictates complexity
  - 1st timer? Simple off-the-shelf, no soldering
  - Old hat? Solder the board or try complex COTS (commercial, off the shelf)
- Use discrete components (individual chips, if you're comfortable)
  - Multiple discrete chips & support hardware
    - e.g. RS485 chip + power supply + support components
- Combine off-the-shelf boards… for example
  - e.g. 1 or 2 Arduino Shields
  - e.g. 1 or 2 Mikroelektronika Click Boards
- Integration of system
  - Breadboard is good
    - Pay attention to clean wiring (aesthetics and reliability)
  - Soldering is harder but better
- Packaging, Power & Display
  - Cardboard box is good
  - Wood, plastic or metal is better

Video work

Do the SAMBA project toolbox survey (https://bit.ly/2SIjGv7) and use the tools at the SAMBA project website to make a really good video.

Important dates

The entire project submission is due on the last official day of class (before the exam period) in December by 11:55pm. A penalty for lateness will be applied.

Suggested topics

While you can choose any project that you wish, if you are still struggling with coming up with a topic consider the following and a suggested list.

Your project should be thought of in the context of your final year capstone project.

- Automated door opener
- Toy trainer controller
- Bird feeder
- Solar powered calculator
- Clock display
- Tamagotchi
- Doorbell and remote chime
- Automated safe
- Simple "Roomba-like" cleaner
- Kinetic sculpture
- Musical instrument
- Weather station
- Home alarm
- Wireless telemetry or data logger (LoRa, ZigBee)
- Anything Bluetooth related (*generally hard!*)
- Background sound alarm
- Building temperature monitor (indoor vs. outdoor temperature)
- Window blind controller
- NFC-controlled inventory system
- … you may suggest some on your own.

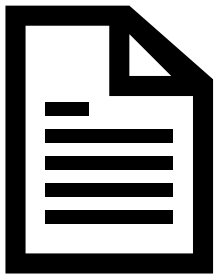
You can also take the minor project (the watering plant project) and augment it to be much more than what was expected in the context of the minor project.

Dangerous projects are prohibited. That means that medical projects, anything to do with direct connections to AC power, anything with sharp objects or cutting surfaces are not permitted. There are plenty of other possible projects that are dangerous and we're not going to deal with those in this class. If you are thinking of doing something that might be considered dangerous, please come to speak with me.

Part 1: Optional discussion of your idea

Feel free to discuss your idea with me during office hours or during in-class sessions. No official submission is required for this.

Part 2: Final Submission



The final submission is due in December, on the last day of class, by 11:55pm. You are to submit both a report and a video. Both the report and the video will be evaluated according to the course learning outcomes. Each is supposed to tell the story of your design work. The video is to be about five minutes long. The report is to be approximately five pages long. Read on for details.

The Report

Make sure to use the following headings in your report.

INTRODUCTION
- A short description (three to five sentences)

CONTEXT:
- Describe "what" and "why"

TECHNICAL REQUIREMENTS / SPECIFICATIONS
- List of things that the system should do. A drawing (schematic) can be included here.
- You can be more general and less formal ("requirements") or more specific and formal ("specifications")

COMPONENTS LIST: [*as you built the device*]
- What was in your system? Write a bulleted list. Provide descriptions to clarify details.
- A photo of the system is appropriate here.

PROCEDURE:
- Describe the process that you used in creating your project.

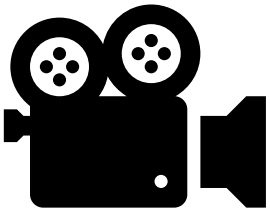
TEST:
- how did you test that the system worked?
- Got graphs showing the results of tests? (power, etc.)

CONTINGENCY
- Did you have one idea in mind but have to execute a different one because things didn't work out as planned? Reflect on this. What would you do differently next time? Looking ahead to ENG 4000 are there any lessons you learned that you would like to apply?

ADDITIONAL MATERIAL
- Especially, anything to do with making your project "holistic". Tie in context of the project and discuss any social, political or environmental aspects about your project that you believe makes it a candidate for "exceeding expectations."

CONCLUSION
- Wrap up in a few sentences.

The Video



The video is to be about five minutes in length. The video format and approach are more free form than the written report. Keep in mind that the assessment is not free form, though. It is evaluated the same way, using the rubrics as the written report. During your video you need to not only showcase your project, but you must also address aspects of the following.

Fill out the consent form and complete the follow-up survey on using your smart phone to create videos for class: https://bit.ly/2SIjGv7

Review this video for general skills **about video creation** for student projects:

- https://www.youtube.com/watch?v=pzDbPOg1rxs

You should be creating a **narrative video**, with voice over or text subtitles. What does a narrative video look like? Have a look at this example:

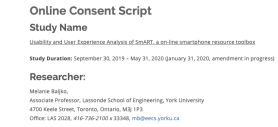
- http://samba-toolkit.eecs.yorku.ca/knowledgebase/what-does-a-narrative-video-look-like-when-submitted/
- Alternate link: https://www.youtube.com/watch?v=KjycUDQHcnE

When planning your video, please review **best practices** to ensure that you are creating the best possible video to showcase your project while also respecting the **privacy**, security and safety of others. Review

1. **Ethics** best practices: http://samba-toolkit.eecs.yorku.ca/video-media-release-best-practices/
2. Ethics **decision trees**: http://samba-toolkit.eecs.yorku.ca/media-release-tool/

Make sure to fill out the consent form for the study on making videos with your smartphone video:

1. https://tinyurl.com/qqxxszc
2. https://bit.ly/2SIjGv7



Online Consent Script

Study Name

Usability and User Experience Analysis of SmART: a on-line smartphone resource toolbox

Study Duration: September 30, 2019 – May 31, 2020 (January 31, 2020, amendment in progress)

Researcher:

Melanie Baljko,
Associate Professor, Lassonde School of Engineering, York University
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Also, you want to demonstrate the **best technical featu**res of your project. Have a look at this example of a Nursing student illustrating technical skills. What technical skill from your embedded systems project can you illustrate in your video?

1. http://samba-toolkit.eecs.yorku.ca/knowledgebase/what-does-a-technical-student-skill-look-like/

Detailed Marking Guide for Final Submission (Part 2)

We will be evaluating the following learning outcomes via their general GAI attribute descriptions. **Both** the **Report** and the **Video** will be assessed using these rubrics.

Report (CLO 1)	Grade	CLO 1: **Use a set of soft computing skills such as reasoning about algorithms, tracing programs, and test-driven development for programming applications** (*GAI: Demonstrate skills in computer programming, data analysis and graphical visualization)*	Note
	Report /4 Video: /4	1. Does not demonstrate skills in computer programming, data analysis and graphical visualization 2. Demonstrates marginal skills in computer programming, data analysis or graphical visualization 3. **Demonstrates competency in computer programming, data analysis and graphical visualization** 4. Demonstrates superior skills in computer programming, data analysis and graphical visualization	
Report & Video (CLO 2)	Grade	CLO 2: **Explain and apply the fundamental constructs in procedural programming, including variables and expressions, control structures (conditionals/loops), and documentation** (GAI: Demonstrate skills in computer programming, data analysis and graphical visualization)	Note
	Report /4 Video: /4	1. Does not demonstrate skills in computer programming, data analysis and graphical visualization 2. Demonstrates marginal skills in computer programming, data analysis or graphical visualization 3. **Demonstrates competency in computer programming, data analysis and graphical visualization** 4. Demonstrates superior skills in computer programming, data analysis and graphical visualization	
Report & Video (CLO 3)	Grade	CLO 3: **Write simple programs using functions defined in m-files** (*GAI: Select and adapt appropriate equipment and tools to perform tests or measurements*)	Note:
	Report /4 Video: /4	1. does not select appropriate equipment or tool to perform tests or measurements 2. Selects equipment and tools but usage shows little awareness of the tools' capabilities and features; selects tools based on personal preference; 3. **Selection of equipment and tools is based on criteria and close to standard practice; adapts equipment and tools if necessary to perform tests or measurements** 4. Selection is based on sound criteria; and is the most appropriate choice adapts equipment and tools to improve performance of tests or measurements	
Report & Video (CLO 4)	Grade	CLO 4: **Use the computing environment to implement/simulate selected applications from science, math, and engineering** (GAI: Demonstrate knowledge of the concepts of mathematical modeling)	Note
	Report /4 Video: /4	1. **Does not construct a mathematical model; does not grasp the connection between mathematical models and systems** 2. **Constructs mathematical models that describe systems, but models are inconsistent, incomplete and/or assumptions are flawed** 3. **Constructs mathematical models that correctly/adequately describe systems and uses appropriate assumptions** 4. **Constructs mathematical models that correctly/adequately describe systems, and identifies limitations of models**	

More on the Rubrics & Marking Guides

In many Lassonde courses, like ENG 4000, we use qualitative criteria to assess students. Both students and faculty have noted that it gives a very different flavour to assessment. Most students will end up in the meeting expectations category, which maps to a "B" to "B+" range of traditional grades.

Rubric Numeric Score	Rubric Description	York Description	York Letter Grade
4	Exceeding Expectations	Exceptional	A+
3.5		Excellent	A
3	Meeting Expectations	Very Good	B+
		Good	B
		Competent	C+
2.5		Fairly Competent	C
		Passing	D+
2	Marginally Meeting Expectations	Barely Passing	D
1.5		Marginally Failing	E
1	Below Expectations	Failing	F

While you may aspire to a perfect ("100%") grade, the reality is that very few actually do on a properly designed learning activity. Yes, there will be some of you who will both aspire to and achieve an exceptional result in your project and, so, your project may be categorized as "exceeding expectations". It's not that others have done anything "wrong" but, rather, they have met the targeted learning; that is, they have "met expectations" of learning, which corresponds, when mapped to a traditional score, like a B or B+.

How will this play out in the project? To at least "meet expectations" you need to do so in all of the assessment components, both for the submission after reading week and for the submission at the end of the semester. This, typically, will mean that your project has also met all of its technical goals and that you didn't have to fall back on your contingency plan.

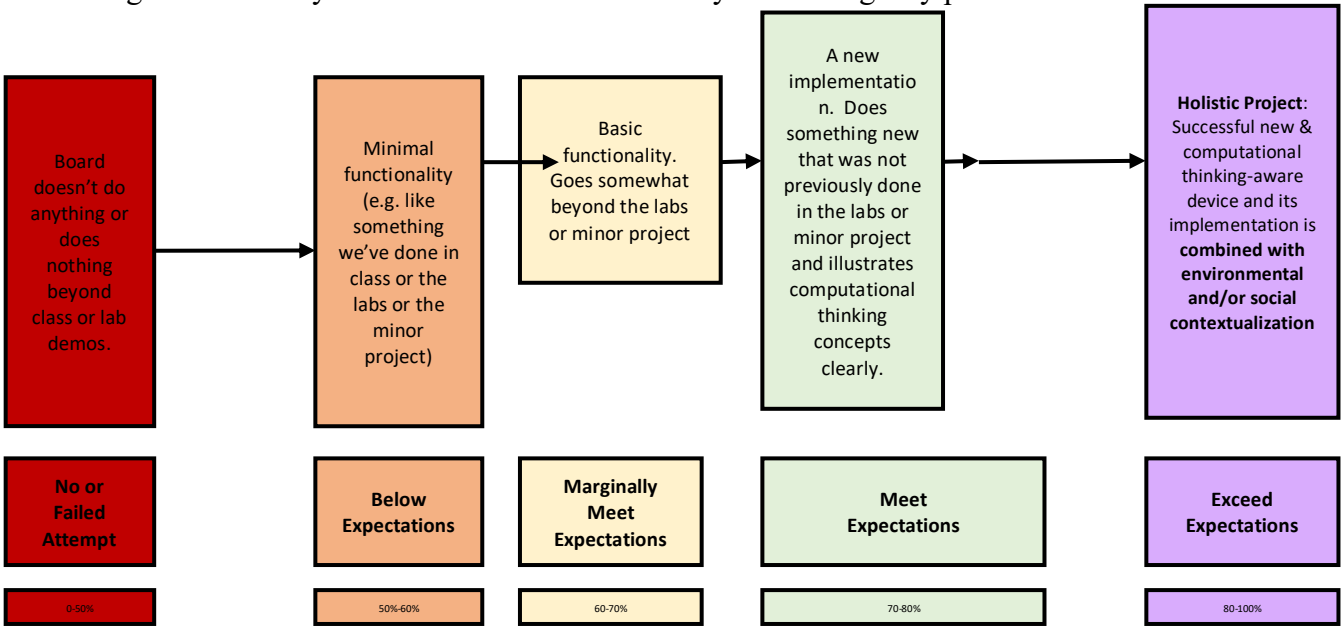

Figure 1 Overview of rubric assessment in context of project development.