ASEN 4067/5067 Microavionics Final Project 2021

The following are all of the deliverables for the final project:

Deliverable:	**Percentage Weight:**
Project Idea Presentations	10%
Biweekly Status Meetings	NA
Project Proposal	40%
Project Parts Check	3%
Final Presentation and Videos	45%
Peer Review	2%

See the Schedule for Due Dates and Times

OBJECTIVES:

This assignment describes the final project for ASEN 4067/5067 Microavionics. The final project is worth **15% of your final grade** in this course so start early to ensure that you are successful. During the semester you will learn about the fundamentals of a PIC18F microcontroller including the architecture, internal hardware resources and programming both in assembly language and C. Learning during the semester will occur by completing biweekly labs that are defined to focus on a specific system or subsystem related to the microcontroller and microavionics. The purpose of the final project is to provide an opportunity for you to explore the functionality of a microcontroller, integrate sensors and actuators that were (or were not) used in class and develop an embedded systems project of your choosing.

The basic requirements for the final project are that you integrate a PIC microcontroller to an input and an output device and develop firmware that runs on the microcontroller. Most students develop a project with the Microavionics board used in class for your final project. (You can use a different PIC development kit and processor, the only restriction is that *you are using a PIC family processor*.) You can develop your firmware in either C or assembly, or a combination of both! For your project it is recommended that the majority of code be in C.

The projects that you can do for this assignment are only limited by your imagination and resources. You will need to purchase or borrow any additional sensors, actuators, hardware, etc. Project success does not depend on the cost spent, the focus in on the code development. Projects can be fun and useful and/or related to Aerospace applications. Some examples of previous projects include the development of smart devices such a passcode system for a doorlock, automatic plant watering system, etc. Another example project is a solar tracking device that uses a photodiode to determine the location of the sun (light source) and then utilizing a stepper motor to articulate the position of solar panels (mock or real) to track the "sun", or a satellite thermal control system, or servo actuated foam core airplane control surfaces, etc.

In developing your project it is very easy to take on a project that is too ambitious and cannot be completed in the time allocated or too easy and does not meet the expectations for the course. To avoid this problem you should spend some time clearly thinking about your project and defining the scope and discussing with the course instructor and assistants. If you want to attempt a complex project, first break the project down into manageable subprojects. Then when defining your project you should be sure to scope a project that you feel can be comfortably completed in the time available. Don't forget that you will also have assignments from other classes that will be putting pressure on your time. If you accomplish your core project goals before the project is due you can always add additional bells and whistles. This is preferable to the alternative where you attempt a project that is too complicated and then when the project is due you don't have anything working to demo. Great projects are ones you really care about—a personal project, something related to senior design, grad projects or your research area.

ASSIGNMENT:

1. **Project Idea Presentation (10%)**

   The Project Idea Presentations provide an opportunity for you to receive feedback from a member of the teaching team about the quality and scope of your project. **The Project Idea Presentations will last 4min. You will have 2min to present your project idea, and 2min to receive feedback and answer questions.** Your presentations should follow the structure outlined in Table 1. Remember, the more detail you include in your presentation the better feedback the teaching team will be able to provide.

Slide Number	Slide Content
Slide 1	Project Overview and Scope • Clearly define project idea and scope. • Outline levels of success • Images and diagrams are strongly encouraged
Slide 2	Hardware and Software • List any hardware and software you plan to use including peripheral devices. • If there are components you are still identifying, explain what you are looking for and what information you need. What are the next steps?

Table 1: Project Idea Presentation Slide Content

   Submision Guidellines:

   - Submit your presentation to the **Gradescope Project Idea Presentation** assignment using the filename **Lastname_Firstname_Project_Idea_Presentation.pdf**.
   - **NOTE: You must submit your presentation slides as a PDF document.**

2. **Biweekly Status Meetings (Ungraded)**

   Biweekly status meetings will be held during lab every other week after the Project Idea Presentations (See schedule for details). A member of the teaching team will check in with you during lab to discuss the status of your final project. Though these meetings are informal and ungraded, plan on coming to lab prepared to demonstrate your progress. Remember, the more prepared you are for these meetings, the more feedback the teaching team will be able to provide.

3. **Project Proposal (40%)**

   By this point you should have your parts selected.You should be able to describe the hardware interfaces that will be used (I2C, RS232, ADC, etc.) to interface your sensors and actuators to the microcontroller. You must also be able to describe the timing schemes that will be employed in the software and the major software functional elements. Be sure to identify any interfacing hardware requirements such as motor drivers, MOSFETS, op amps, signal conditioning, etc. For this assignment, submit a Project Proposal Report containing the sections as detailed below. This should be a short report but rich with details and content.

   (a) **PROJECT Overview:**

      i. One or two paragraphs describing the project
      ii. Describe the core functionality of the project. What are the elements that your project must have?
      iii. What are the levels of success for your project? Make sure to clearly distinguish between the base functionality and your higher levels of success. **Include off ramps to reduce risk if the project does not go as planned.**

(b) **GRAPHICS:**

i. Include a software flowchart, showing the logic and subroutines for your project. Use standard flowchart symbols. (Ask in office hours if you are unfamiliar with standard software flowcharts).

ii. A functional block diagram (FBD) of the project

A. A good functional block diagram shows each functional component, its purpose and how it interfaces with the rest of the components.

B. What is the purpose of the items coming into and leaving each component?

C. List the board resources that you will be using i.e. peripherals, channels, sensors, external circuits, etc.

iii. An Electrical Wiring Diagram

A. Show exactly what pins are used to prove you have enough pin resources, what voltage and current, what protocol, etc. for each electrical component including items already on the PIC if applicable (LCD, DAC, SPI, etc.).

(c) **RESOURCES:**

i. A Bill of Materials (BOM)

A. Parts, price and order status

B. Manufacturer and weblink(s).

(d) **STATUS:**

i. What is the current status of your project?

ii. What aspect(s) of the project are you most concerned about? What risk(s) do you foresee in the project and how do you plan to mitigate them with advanced planning and time for off ramps?

Submission Guidelines:

- Submit your document to the **Gradescope Project Proposal** assignment using the filename **Lastname_Firstname_Project_Proposal.pdf**.

4. **Parts Check (3%)**

In lab you will be required to show that you have acquired all of the parts for your project. Obviously if the parts are not acquired in a timely manner you will be delayed in the construction of your hardware which will directly impact the success of your final project. This is simply a check on the status of your hardware to see that you have all your parts in hand and have begun the hardware integration process. The most time consuming part of a project is often understanding and troubleshooting the hardware interface. The sooner that you start understanding this interface the higher the probability that you will be successful on your project.

5. **Final Presentation and Videos (45%)**

The Final Presentations will be given during finals week instead of a written final exam (see the schedule for details). You should dress professionally and arrive with your presentation well rehearsed. **You will have 10min to present your final project to a member of the teaching team. This 10min includes a hardware demonstration as well as 2min for questions and discussion.** You **must** embed a video of your hardware demonstration in your presentation slides. That being said, if you are also able to demonstrate your hardware in real-time that is strongly encouraged in lieu of playing the video. The purpose of the video is as a backup and documentation for the project achievements. The following rubric will be used to grade your presentation.

(a) **PRESENTATION SLIDES CONTENTS:**

i. Overview of your project including project goals/levels of success.

ii. Summary of the hardware and software implementation

iii. Description of what was ultimately achieved and how the project works.

iv. Description of the obstacles that were encountered and what you learned, demonstrate understanding of WHY it worked or did not.

v. Professional style and quality of the presentation and slides.

(b) **HARDWARE DEMONSTRATION:**

i. Demonstrate the hardware working and current project success. You must have a recorded video in your presentation, but you may choose to forgo showing that video in favor of a real-time hardware demonstration.

ii. Verbal explanation of the software operations and coding techniques implemented.

iii. Verbal description of any off-ramps used and future improvements.

iv. Level of difficulty rating

Your final presentation should be submitted by the due date listed in the schedule.

This time should be used to highlight the successes of your project and what you learned from what didn't work. Even if you were not able to reach all of your project goals you should have a demonstration that shows what you do have working and be prepared to discuss why it works or does not in order to demonstrate **full understanding of the project performance**.

Submission Guidelines:

- Submit your presentation slides and embedded hardware video demonstration to the **Canvas Final Presentation Videos** assignment. Use the filename **Lastname_Firstname_Project_Presentation_Videos**.
- Ensure that your videos are viewable from your Canvas submission. Do not embed your video(s) using a google drive link, as the teaching team and peers may not be able to access your files.

6. **Peer Reviews (2%)**

Each student will be assigned two other student's Final Presentations to review. You will get 2 points for completing a peer evaluation form (watch Canvas for details). The peer reviews are a critical part of the cross learning that happens in this course when you see other student projects. These will also be used by the teaching team for alternative viewpoints/feedback to adjust borderline grades but will not be factored in directly to the calculation of each student's final grade.