Electronics Capstone Project: Final Report Guidelines

ORAL REPORT

(2.45 - 4.15 pm, Wednesday, April 03, 2019)

Each team will present and oral report, approximately 10 min total (nominally 7 min presentation + 3 min for questions). The presentation should cover in succinct format the same 4 main pillars described below for the written report. It should also include a live demo showcasing your project's state of the art. The order/schedule is TBD.

WRITTEN REPORT

(Due 5pm, Thursday, April 11, 2019)

Each project group will submit a *single* written report. All reports should be submitted electronically with a filename containing the initials of each team member (e.g. ElectronicsFinalReport_LS_SK.docx). See also *What to Submit: Checklist* below. You are invited (read: strongly encouraged) to submit a rough draft for review and feedback anytime up until Apr 05, 2019. (This will leave sufficient time for the instructor to read it and provide feedback, as well as the project team to incorporate feedback).

Formatting:
Double space all text. Figures and tables should be numbered successively with captions (use right click > Insert Caption…). Place figures and tables on their own lines, NO text wrapping. Number/Label each section per subject heading described below.

Style/Target Audience:
The final report should be written targeted for an audience competent with basic Engineering and Electronics principles. The prose/style is flexible, so long as it clearly, concisely, and accurately communicates the following:

I. INTRODUCTION/PROBLEM STATEMENT
What are you building and why? What is the real world application of your electronics-based system?

II. SYSTEM DESIGN

a. **System Overview**: What is the theory of operation of your system? This "block diagram" level, the overarching big picture how multiple components (sensors, microcontrollers, etc) work together to achieve the project aim. It also describes how does the user interact with/control the system? Be sure to include the actual block diagram as a figure in your final report. In terms of text, you might have sentences something to the effect of "Our system uses a differential pressure measurement to compute the volume of water in the camelbak bladder. Pressure sensor 1 (MPL3112A) is mounted at _____ and measures the ambient atmospheric pressure (Patm). Pressure sensor 2 (MPRL) measures the pressure at the bladder which includes the additional pressure due to the fluid column above (Patm + Pwater). The microcontroller reads the pressure from each sensor and then computes the difference to find Pwater. Then we relate Pwater to the volume by _________. The Feather board connects to the users smartphone via Bluetooth low energy, and tracks/reports the fluid volume every 30 s."

b. **Technical Details--Component Selection and Wiring:** This section should fill in the details of the system overview.

   i. **Schematic & Wiring List**. Clearly detail how all components are wired. One recommended strategy is to grab photos of your components from sparkfun/adafruit/etc, import to powerpoint, use autoshape lines/wires to show connections. Additionally, you must include a wiring list in table form. specifying which pins are connected together on two devices. For example:

Melexis 90640 IR camera	Teensy 3.6
3.3 V (red wire)	3.3V (nearest pin 23)
GND (black wire)	GND (nearest pin 0)
SCL (yellow wire)	Pin 19 (SCL0)
SDA (blue wire)	Pin 18 (SDA0)

   ii. **Photo of Completed Prototype**. This may include electronics as well as any other mechanical components. Adding text arrows annotating various aspects is also very helpful.

   iii. **Component selection rationale**: What is the rationale for each component selected? And for each software package used (if applicable)? For instance, if your system required an IMU, there are many choices out there—why did you choose the one you did? Ditto for the microcontroller boards (Feather BLE vs LoRa vs. Teensy + Bluetooth add-on). Briefly justify rationale for *each* component in the system. For instance, "We used the Adafruit Feather 32u4

LoRa development board because data packets could be transmitted over _____ meters. Transmitting data over this distance was important for our project because _____. Our maximum wireless data bandwidth was computed to be _____ bits/second, well within the LoRa specification of 27 kbps maximum bandwidth. Additionally, the feather board offers hot-swappable LiPo charging circuitry, for wired as well as wireless operation. Finally, the board is compatible with the Arduino IDE making it easy to program."

iv. **Bill of Materials**. Make a detailed list (Excel Table format) of all parts used (electronics and mechanical) in your final design. Column heading should include: Description | Part Number | Vendor| Quantity |Cost. Yes, you can and should copy and paste, revising as needed, from your BoM submission earlier in the term!

III. PERFORMANCE TESTS AND RESULTS

This purpose of this section is essentially to establish proof-of-concept that your system works as intended, and/or examine and quantify any limitations thereof. You should establish that the system functions as intended. To this end include details of:

a. **Testing/evaluation procedures**. How exactly did you evaluate the system, what were your procedures for doing so, what did you measure/quantify?
For example: "To assess the performance of our system, the lidar system was positioned in the Great Hall and set to scan at 4 Hz. A person walked across the space along a pre-defined path from the stair case toward the doors of the IQ center. Meanwhile, the test subject was outfitted with two-channel headphones compatible with generating binaural sounds. The test subject was tasked with navigating toward the walker by sound alone. To quantify how well the test subject could track the moving target (walker) we measured ______________." Or you might have something like "We attached our remote bridge sensor to a _____ cm drawbridge at a position ____ cm from the main buttress. The bridge was raised and lowered manually to different angles in the range of ____ to ____ deg using a protractor. The trajectory of the bridge was similar to an actual drawbridge observed in Stuart, FL. We measured two outputs from our system: the angle vs time, as well as the status which could be any of the following 4 options…"

b. **Results and interpretation:** What were the outcomes of your testing? How do you interpret those? Does your system work as intended? If not, what limitations/shortcoming do you note? For example, you might have something like "Our IR sensing 'BradyBot' successfully hit the target in 9 out of 10 trials at a target distance of 3 m; and hit the target 6 out 10 trials at a distance of 5 m. For the misses, the distance between the throw trajectory and intended target was 1.0 +/- 0.5 m for the 3 m trials and 1.7 +/- 1.6 m for the 5 m trials. Thus, our robot is highly accurate at short throws and somewhat accurate longer throws. By comparison, Tom Brady completed 63% of passes within 10 yards, and 47% of passes within 40 yards."

c. **Short video demonstration**: This should be an approximately 1-2 min video showing your wonderful Electronics system in action (to impress and inspire future generations of Electronics students)! Provide a brief text description. For instance "Our demo video shows the smartrock submerged in water to different depths. Correspondingly, the pressure changes, which can be seen in the Arduino Serial Monitor display (0-30 s). We also plotted the linear acceleration vs time as we manually moved the smart rock up and down in repeated fashion (30-60 s)."

IV. DISCUSSION

This section should critique how well did your final product met the design objectives outlined in the Introduction/Problem Statement. Highlight design aspects which were particularly nice (go ahead, toot your own horn, you deserve to!) Also, remark upon any features which could be improved (this is almost always the case). Make specific suggestions of future work and improvement.

WHAT TO SUBMIT: CHECKLIST

Please be sure to check all of these boxes for your final submission in electronic format. Submit all final report materials to a box folder with your project name + team member initials. All hardware components must be returned to the instructor. Upon consultation/approval, you may take part or all of your project home with you.

- ✓ Oral presentation visuals (typically powerpoint slides)
- ✓ Final written report in .docx or .pdf format
- ✓ Live demo/walk-through video
- ✓ All code for Arduino, RasPi, etc. Please submit native file formats—e.g., .ino and .py (not copied and pasted text)
- ✓ All hardware + mechanical components returned to instructor
- ✓ Brief statement that your lab station is thoroughly cleaned up, all parts put back in proper location. Thank you in advance for contribution in minimizing entropy!

GRADING SCHEME and CRITERIA

The final report (oral + written) counts for 60% of your total grade in the course (per course syllabus). The grading scheme will be as follows: The final report will be assigned an overall grade, max being 100 pts. The total number of points to be distributed amongst your group members is equal to Final Report Points x Number of Group Members = 200 points, max. Each group must submit a joint statement of each group member's contributions and apportion the points as deemed fit. For example, let's say you write an awesome report which receives a score of 100. If you all agree you did an equal amount of work, everyone gets a 100, hooray! Another example: Let's say one group member was really outstanding and went out of his/her way to make the project really happen. You might decide to award them a bonus 10 points, sacrificing 10 points from other team member, so the scores would be 110 and 90, respectively. If the final report of this group had received a score of, say, 90, then the final points awarded to each student would be 90 and 90 or 100 and 90, respectively, for the examples above.

Grading will be based on the following criteria:

- Is design based on proper electronics principles?
- Is design properly executed?
- Is design properly documented and described? Has full justification for design been provided, demonstrating full mastery of electronics knowledge?
- Was the system properly evaluated to analyze overall performance?
- Does a cogent narrative discuss the pros and cons (benefits and limitations) of the current design, and offer suggestions for how to improve the system?