Communicating Design Details and Rationale
Capstone Design—Winter 2021
Due Date: 4pm, 17 Mar 2021

Warm up

Let's start this little exercise with something (hopefully) familiar, an electric guitar. It has electrical parts as well as mechanical parts (sound familiar—capstone robot, anyone?). Using Figure 1, plus any addiitonal knowledge you have of guitars or musical instruments in general, describe the *design details* of the guitar design. Be specific! The point here is to get your juices flowing in how to clearly and concisely describe an everyday object. Later, we'll translate this your robot design!

Figure 1: Cort brand CR100 model electric guitar. Inset highlighs the audio pickups. Figure adapted from: `https://www.cortguitars.com/product/item.php?it_id=75`.

Capstone Design: Communication Objective

This purpose of this section (ultimately part of your final report) is to address the ***what*** and ***why*** of your system design. Thus, this section needs to communicate ***details*** of the engineering design, and ***rationale*** for those design decisions. This section should both provide information on both individual components as well as how they are integrated into the over design. Remember that your primary audience is your client, as well as other stakeholders.

Strike a balance: provide salient design details, but don't burrow too far into the weeds. A general rule of thumb is that you should provide enough detail that another engineering competent person could replicate your design from your writing alone. This document—ultimately a core section of your final report—should also convey rationale insomuch as the trade-offs made (benefits vs. limitations) are transparent to the reader.

Lastly, keep in mind The focus should be on what design aspects you did include in your final design, as opposed what considered but opted not to include in the end. That said, it is important to present alternative design aspects considered along the way, highlighting why they were ultimately not chosen.

The questions below are meant to help guide your thinking. It may be helpful at first to jot down answer to each, but ultimately you/your subteam needs to ***draft a prose narrative which can be essentially copied and pasted into your final report***.

To summarize the flow of this workshop:

1. As a team formulate clear, concise, and specific answers to the questions below (30 min).
2. Each team will share their answers with the another team (10 min) who will offer substantive feedback to help hone clear thoughts and clear writing.
3. Incorporate the feedback from the other team
4. For the **written document submission (Document II)**: Use your answers and thinking from the workshop as a springboard to write a formal document which will ultimately become part of your final project report. The final product will use a regular, flowing-style of prose organized into subsections as you see fit, not a bullet point list of answers.

Break it Down: Road map of smaller questions to address the how and why

1. **The Big Picture:** What is the overview of your design (the 30k foot flyover view)?
2. What graphic(s) will you include to best convey the design overview? Make a list and include temporary place holders.
3. **Details, details, details!** What are the important *details* integrated into the engineering design? For instance, here are some examples to think about. By no means is this meant to be a comprehensive list—rather it is just to get the juices flowing:
    (a) What shocks are part of the suspension system, and how are they configured in the final suspension system? The engineering crowd want part numbers, approximate spring and/or damping constants. What omniwheels and why? How exactly are they fastened? What nuts and bolts (part numbers, please!) did you choose
    (b) What are all of the parts of the arm gripper system: rocker, crank, base, etc? What motor drives the crank and how is it coupled to the crank? What D-bore coupler did

you use? How is the motor mounted? What are the dimensions of the gripper? How is it wired?

(c) What is the design principle of the 10 Hz EMF detector? What does your circuitry look like? How is the data acquire and processed? What information does it send to the central brains RasPi? How is the final design constructed and assembled? Where is it mounted on the robot and why?

(d) How is a Wifi connection established? What data is passed back and forth? Specify how are data packets formatted? What features are included in the GUI dashboard? What do various graphics, colors, indicators show?

(e) How does the driver steer the robot? When you push buttons or control joysticks, what data is actually being sent to the motors? For turning? For straight line?

(f) How does the camera acquire images? What is it mounted on? What are the dimensions of the mount? What type an length of cable is used? How does the camera pan to look around the room/competiton course?

(g) How many and what type of sensors are used for navigation? What part numbers? How are they interfaced to the RasPi? What is the algorithm for deciding how the robot moves within the course?

4. List graphic(s) will you include to best convey these components and how they fit together into the overall design? Beautiful graphics take a LONG time to make, but they arguably the most important conveyor of information. So plan to spend a lot of time on them to get them just right.

5. **Why, oh why, oh why?** Explain in clear terms the ***rationale*** for each design decisions made. For instance, why did you choose X wood over Y wood type? What advantages did place bridge footers x meters apart offer? Why was silicone used for a swirl design instead of aluminum? Each design decision made needs to be paired with clear rationale in the report.

6. Summarize the benefits and known limitations of the design.