ENGINEER 1P13:
PROJECT FOUR WORKSHEETS (INDIVIDUAL)

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PROJECT FOUR MILESTONE ONE: PROBLEM FRAMING AND TEST PLAN

MILESTONE 1.1 – CLIENT NOTES

Team ID: Thurs-08

Complete this worksheet individually before coming to Lab A for Week 6.

1. Include your client notes from the introductory client visit

Name: Andrew Habib	MacID: habiba21

T:

- Bilateral retinal detachment
- Watching TV remote / menu
- Cannot see insulin pump monitor
- Cooking
- Not knowing where he is in the snow

K:

- Cannot turn on the microwave
- Reaching high things
- Fine dexterity
- Putting on glasses on and taking them off
- Raise the leg so air gets through to the wound

PROJECT FOUR MILESTONE TWO: DESIGN EXPLORATION AND DESIGN REVIEW #1

MILESTONE 2.1 – CLIENT NOTES

Team ID:	Thurs-08

Complete this worksheet individually before coming to Lab A for Week 7.

2. Include your client notes from the introductory client visit

Name: Andrew Habib	MacID: habiba21

- *Need to raise right leg – Right leg needs to be free of any pressure*
- *Don't know what certain function keys due to inability to access them in certain appliances*
- *Tim has a standard cane*
- *Kim has a stylus pen that has a tip that falls off and deactivates and wears down*
- *Kim can lift arms up to horizontal position and is able to lift up to 5 pounds*
- *Tim found difficult to use scanning technology that reads out (Phone use may be easier) – The sensor does not read out loud for the insulin machine*
- *No distinguishable alerts from the insulin machine*
- *Functions of the stove are all touch screen with some Google functionality*

MILESTONE 2.2 – RESEARCH ASSIGNMENT

Team ID: Thurs-08

Complete this worksheet before Lab A for Week 7.

- State the question you plan to answer through your research
- Summarize your research findings (answer). Your answer should be a coherent, well-written summary of your research, not a "brain dump".
- You may include images, but don't forget to cite them properly.
- Aim for a length of about 500 words
- Properly cite your sources using IEEE formatted references and in-text citations. For information on referencing formats and choosing sources, see Design and Communication Workshop 1.

Name: Andrew Habib	MacID: habiba21

What is your question?

What are the best testing methods currently available to test mechanical and computational designs?

What is your answer?

There are several ways to conduct tests on mechanical and computational designs. On the side of measuring tools, scales, Autodesk iProperties, and observation to evaluate the weight, one of the most important testing methods for durability and strength is tensile testing (Miniature Tensile tester is one of the available resources). Tensile testing is a critical tool mechanical, and materials engineers use to determine how well a material is able to withstand certain forces.[1] A tensile tester is an electromechanical machine that tests tensile strength by applying stress to a given material until it breaks after continuous deformation. The machine provides information regarding the material's properties based on how the material reacts to the applied force. Some of those properties include stress, strain, or maximum deformation of material using a ratio of initial and final lengths before failing, stiffness, Ultimate Tensile Strength (how much stress the material withstands before breaking), Yield strength, etc.[2] Tensile testing is very important for the material's application to be successful. Different applications involve different forces of different durations associated with them which is why it is vital to determine how well the material can serve its purpose.[1] The data that the machine provides is also useful in ensuring that the material meets given specifications and constrictions. This data would be displayed on a stress-strain curve.[2] The machine itself contains single or double-column loading frames which contain the grips and loading cell to quantitatively analyze the force being applied with the help of software that is used

for inputting appropriate settings, activating the machine, and displaying the data of the test.[1] Although it is possible to test for these attributes in Autodesk Inventor, Tensile Testing using the appropriate machine is important when checking if the application is feasible in real life.

On the other hand, computational designs are possible and they should also be able to fulfill given objectives. Typically, in a software-based solution, the objectives would be consistent in some cases such as having "durable" or bug-free, easy to use / access, and aesthetic like the mechanical solution. There are several ways to test each of these objectives. One method that is applicable would be end-to-end testing which involves allowing a testing user to go through all of the functions of the program to ensure that it works as intended from start to finish. This would ensure that the program is in fact usable and easy to work with. To ensure that the software is bug-free, unit tests may be ideal as this technique involves the testing and debugging of each method in a given file to ensure that each individual component of the software works as intended without compile-time or run-time errors. Performance testing may be used to determine how efficiently and smoothly the program operates under high loads. There are also more objective tests like Acceptance testing which determine whether the program fulfills a client's specifications.[3] Overall, these testing techniques are necessary to design a solution that will work as intended and ensure that the design is helpful and easy to use.

List of sources:

[1] Atlassian, "The different types of testing in software," *Atlassian*. [Online]. Available: https://www.atlassian.com/continuous-delivery/software-testing/types-of-software-testing. [Accessed: 27-Feb-2023].

[2] "Tensile testing machines and testers," *Tensile Testing: Machine and Tester*. [Online]. Available: https://www.zwickroell.com/products/static-materials-testing-machines/universal-testing-machines-for-static-applications/tensile-tester/. [Accessed: 27-Feb-2023].

[3] "Tensile testing machines | an introduction | instron." [Online]. Available: https://www.instron.com/en/resources/test-types/tensile-test. [Accessed: 27-Feb-2023].

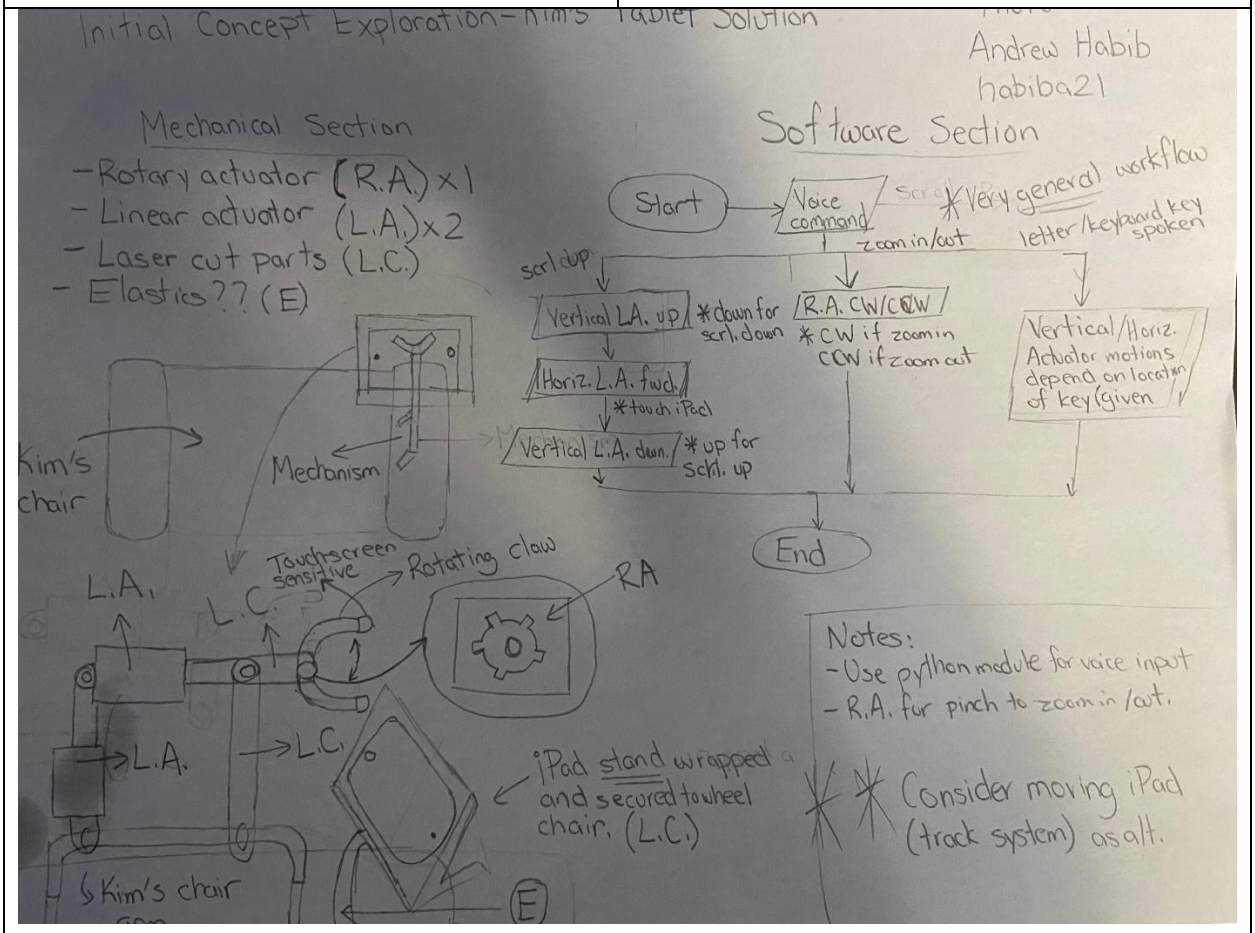
MILESTONE 2.2 – INITIAL CONCEPT EXPLORATION

Team ID:	Thurs-08

Complete this worksheet before Lab A for Week 7.

1. Include multiple images of your **initial** concept exploration, if needed
   - → Include necessary annotations to help in the communication of your ideas
   - → These can be photos of hand sketches, photos of initial prototypes, screen grabs of basic CAD models
   - → Include your Team Number, Name and MacID on *each* concept image
2. Insert your photo(s) as a Picture (Insert > Picture > This Device)
3. **Do not include more than *two* concept images per page**

Name: Andrew Habib	MacID: habiba21



MILESTONE 2.4 – REFINED CONCEPT EXPLORATION

Team ID:	Thurs-08

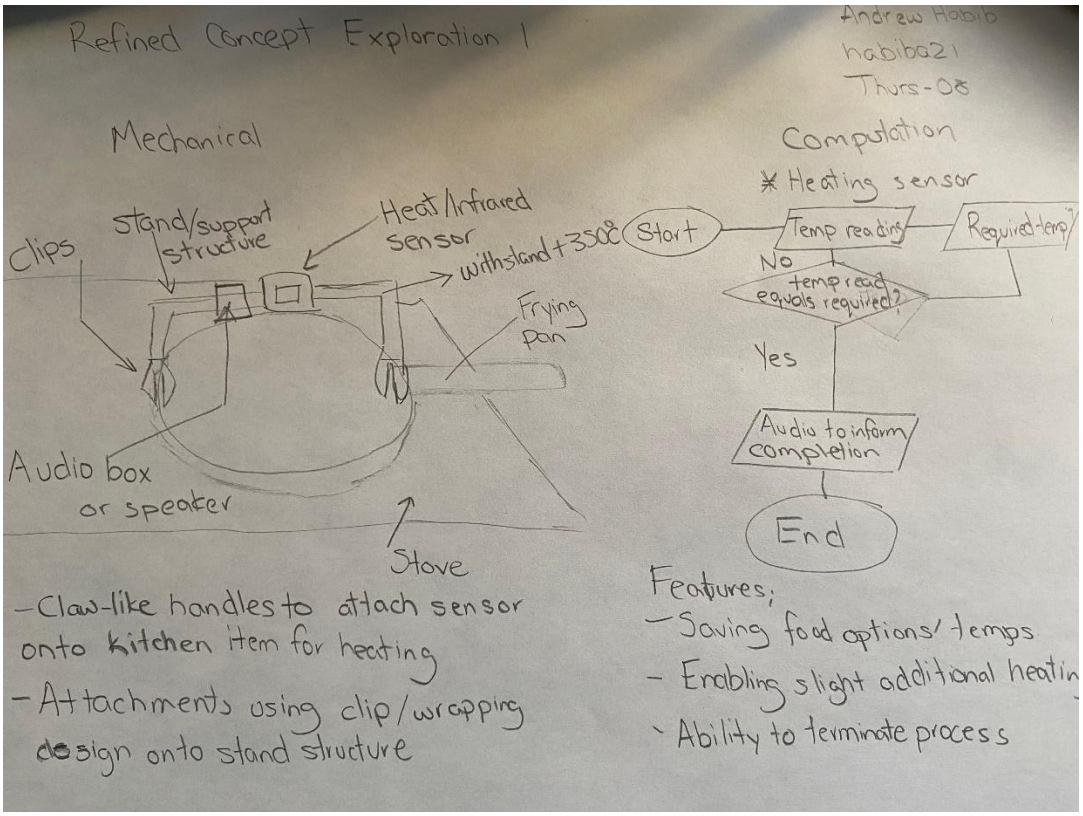
Complete this worksheet <u>during</u> Lab A for Week 7.

4. Include multiple images of your **refined** concept exploration, if needed
   - → Include 2 distinct concepts based on the functional analysis
   - → Include necessary annotations to help in the communication of your ideas
   - → These can be photos of hand sketches, photos of initial prototypes, screen grabs of basic CAD models
   - → Include your Team Number, Name and MacID on <u>*each*</u> concept image
5. Insert your photo(s) as a Picture (Insert > Picture > This Device)
6. **<u>Do not include more than *two* concept images per page</u>**

Concept 1:

Name: Andrew Habib	MacID: habiba21

Insert screenshot(s) of your concept below.

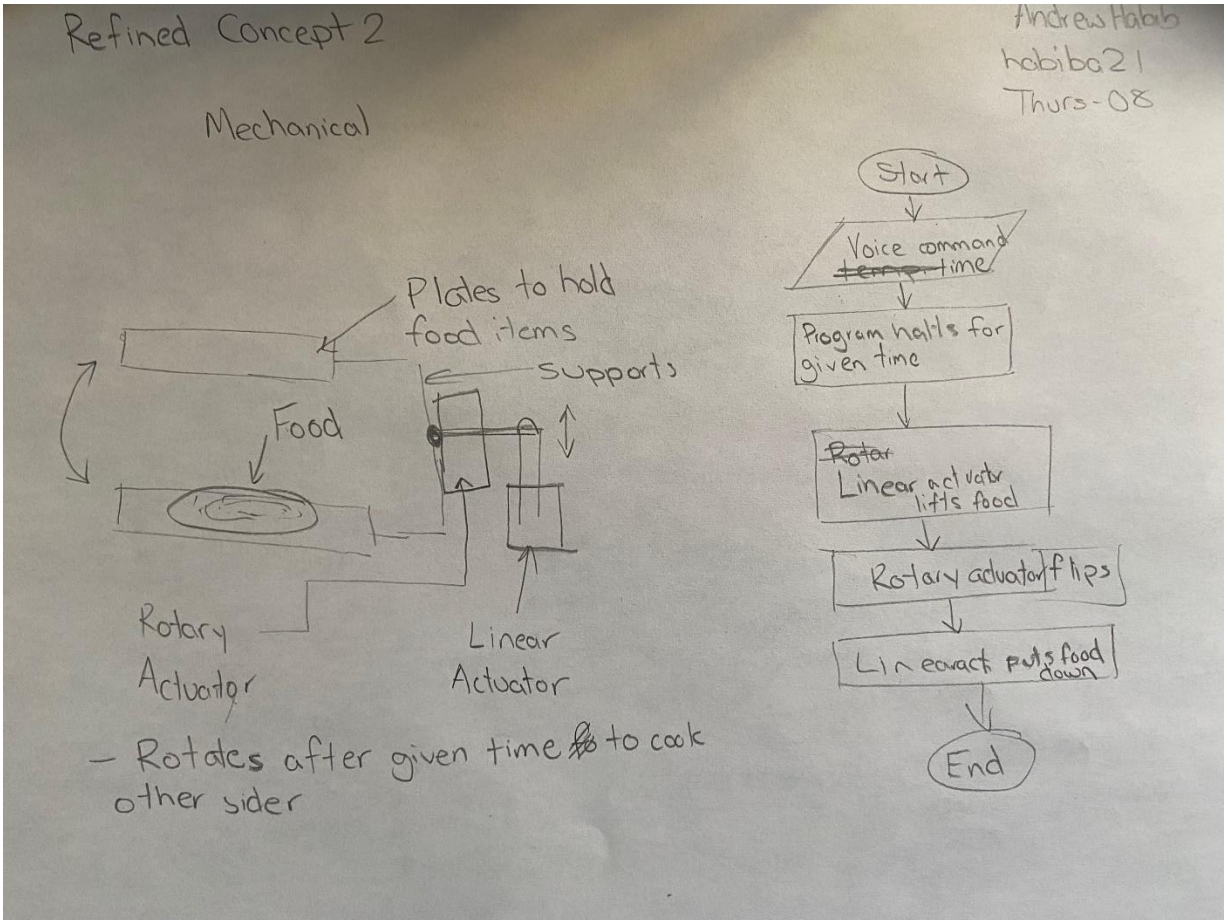


Team ID:	Thurs-08

Concept 2:

Name: Andrew Habib	MacID: habiba21

Insert screenshot(s) of your concept below.



PROJECT FOUR MILESTONE THREE: PROTOTYPING, DECISION MAKING AND DESIGN REVIEW #2

MILESTONE 3.1 – REFINED CONCEPT: INITIAL PROTOTYPE

Team ID: Thurs-08

Complete this worksheet individually before coming to Design Studio/Lab A for Week 8.

1. Take picture(s) of your refined concept (initial prototype)
2. Insert your photo(s) as a Picture (Insert > Picture > This Device)
3. **Do not include more than *two* refined concept pictures per page**
4. Include details on how concept was refined (what feedback was incorporated, what features are different than previous concept exploration, etc.)

Name: Andrew Habib	MacID: habiba21

```
# Importing CV2 from OpenCV (Webcam functions - Access webcam for object recognition and colour analysis)
# Import voice recognition and voice output modules

# Create a list of information for food along with desired rgb ranges for cooked values
# Check if the user has called the device (He wants to start cooking)
      # Voice input for food name
      # Convert audio data into comparable string data
      # Check if the food spoken is found within the list
            # Loop continuously while the desired colour has not been reached
                  # Detect the colour input from the Camera in the form of rgb values
                  # Check if the detected colour input matches the desired rgb range inputed in the list associated with the food's info
                        # Loop while the user has not yet confirmed that the stove is off:
                              # Inform the user through audio that the food is complete and he should turn off the stove
# Terminate the program through a thank you message after the user has confirmed that the cooking is complete.


Potential features:
- Potential feature of adding new foods using voice input commands
- Warnings if overcooked
- Safety feature - Terminate program if the loop continues for too long and the desired cooked rgb values are not reaching
```

Computational Rough High-level Pseudocode

Details:

- *Utilizes data from the camera instead of the sensor for greater accuracy and reliable information*
- *Safety features will be added to account for any unexpected results*

PROJECT FOUR FINAL DELIVERABLE: PROJECT REFLECTION

The activities in this handout are intended to be completed by the end of the project 4. You will apply what you learn in Design Communication Workshop 4 to complete this task.

Submission Details

Each Team Member: upload your reflection essay as a PDF to the Avenue Dropbox titled P4 Reflection using the MacID_P4_Reflection.pdf as naming convention

Grading of Reflection

Your reflection assignment is worth 1 mark of your total Project-4 grade (12.5%). Rubric is provided on Avenue to Learn.

If you need to review the content, go back to Design Communication Workshop 4 and/or go through the online reflecti0on module. Here is the link:
https://ecampusontario.pressbooks.pub/engineeringreflectiontoolkit/

Reflection Activity

Consider your experience with the design process as a first-year engineering student working on Project 4 over the past couple of months in ENG 1P13. After exploring the client's challenges and gaining insights, your team, decided to focus on one area to improve our client's daily life. You have defined the problem in a problem statement that included objectives, constraints, etc. Through this exploration, you performed a functional analysis that was used to come up with different alternative ways to solve the problem. Your team needed to make a decision between the different alternatives, and you tested your ideas for feasibility. You have been encouraged to iterate as you gained deeper insight and developed empathy for the client. Through the process of iteration, you have had the opportunity to improve upon your ideas. Engineers are continually iterating through the design process. Informed designers are involved in continual learning: learning by doing, learning from brainstorming and prototyping, learning by iteration and from feedback and failure, learning by noticing and troubleshooting, learning by drawing and dialoging about ideas, materials, and people. While iteration is an informal form of reflection, you will deepen your understanding of what you have learned through formal reflection. All of these emphasize the metacognitive and reflective practice aspects of learning through design (Lawson & Dorst, 2009; Crismond & Adams, 2012).

Part 1: What?

In this section you will describe a critical incident that you will be reflecting on as related to the "Generating/Testing ideas" and "Decision-making". For each of these steps of the design process:

In three to five sentences, identify and describe ONE critical incident, breakthrough or big thought-provoking moment that either challenged your assumptions, had a positive impact on you or validated your understanding of the design process. Here are some questions to consider.

Generating & Testing Ideas:

- How did you go about exploring ideas?
- How deeply did you explore your design options?
  - How much research?
  - Did you look into Biomimicry tools?
  - Did you consider any "What if?" questions in your explorations?
- Did you test your ideas?
- If yes, how did you test your ideas?
  - What were you trying to test (e.g., desirability, feasibility, etc.)?
  - What tool/ method did you use? (physical prototype, CAD model, etc.)
  - How much time did you spend on testing each idea?
  - How many ideas did you test?
  - How many prototypes did you make for testing each idea?
  - Did you test your ideas early on or waited until you had more details of the ideas?
- What was one challenge that you faced in the testing process of the design? (we encourage you to write more than one challenge). And What did you do to solve that challenge? (you can attach photos to explain your attempted solutions)
- From the results of our testing, one change we made to improve our design solution was … (add your response) and this change made our design solution better because … (add your response).

Response:

When testing different ideas in the initial stages of the project, our first main idea was to utilize a colour sensor to detect colour for our color-detection program. With our previous experience with colour sensors in Project 3 and some additional research on colour sensor technology, our group determined that colour sensors were highly inaccurate and complicated to code most of the time when it comes to slight variations in colour. After difficulty coming up with an alternative, our group was able to come up with a solution using a camera to detect colour accompanied by the open-cv library in Python found online with research and videos displaying how the software works. To test the accuracy, we created a sample program to return the RGB values it was reading from a colour wheel and the results were optimal for our application as the values being returned were very close with only an error of about -+10 due to camera quality.

Decision Making:

- What happened during decision-making?
  - Where in the process, relative to the design process steps, did you make decisions?
  - What were the decisions about? Decisions could be about the process (e.g., how much searching of the design space was enough?) or about the design (e.g., which alternative to prototype).
  - How many options did you have to choose from?
  - How many criteria did you have to compare the options? How did you choose those criteria?
  - What tools did you use to make a decision?
- At what stage did you make a decision?
- When did this experience take place? Did you already have one final solution in mind or you were still exploring the ideas?
- What challenges did you face during decision-making process?

Response:

During the decision-making process, we used a decision matrix to determine which solution would be efficient, accurate, portable, and durable. Subsequently, we used a decision matrix to evaluate between a pan clip, counter mount, hand-held solution, and a pan handle mount for the physical model and sensors or camera-based detection for the computational aspect. The final decision was made 3 weeks into the project during milestone 3 where we chose to utilize a handle clipped to the pan carrying a camera that would detect colour in RGB form. The handle accompanied by a colour-detecting camera was an accurate, simple, heat-safe, cheaper, and more user-friendly solution in comparison to the other solutions. Overall, we felt confident that we had come up with an idea that was realistic to execute in the time frame given unlike the previous solution involving a sensor.

Part 2: "So What?"

In this section you will explore what you learned and describe why this incident matters to you.

In three to five sentences, discuss what you learned from this incident about idea generation, testing ideas, and decision making and that either surprised you, made you confront a misconception, or improved your understanding of the design process.

To help you think about this, consider the following:

- What was the outcome of early or late testing processes?
- Do you think delaying any of your decision-making may have improved the design?
- Could you have collected better observations or data that would have led to better decisions?
- Did you repeat your decision-making process at any other stage?

Response:

As a result of our challenges in coming up with a realistic idea to execute in a tight time frame, our group went through many iterations and ideas to finally come up with a useful idea. In the initial stages, our group discussed many ideas such as using sensors which may have seemed like good ideas initially but when understood in more depth, we determined they were too difficult and inefficient. It was important for us to take time to research sensor technologies along with alternatives before making conclusions which paid off when we found the open-cv python library that allowed us to detect colour much more accurately with RGB values while also being much easier to program. It was possible for us to go through more tests with colour sensors using a sample program and explore other sensor options as well which would have given us more decisive data in terms of accuracy. Decisively, our group learned the value of researching and testing to determine what the optimal solution is.

In two to three sentences, explain why these new insights are important to you.

Response:

These insights were important for our group as we learned what it truly takes to come up with a producible product that serves its purpose well and is realistic to design. Without researching existing solutions and alternatives, our group would have run into lots of performance issues making our product less helpful to our client. Despite our initial beliefs regarding the effectiveness of sensor technology, our thorough tests and research allowed us to use a different approach with colour-detecting camera technology.

Part 3: "Now What?"

In two to three sentences, discuss how you will integrate this new insight into future design projects, including next week prototyping and design review 2 where you still have a chance to improve your design. To help you think about this, consider the following:

- I learned that... (Express and important learning, not a statement of fact)
- This learning matters because... (Consider how this learning has value to you as an engineer)
- How will I apply my learning?
- How will I design differently next time?
- How will I deal with a similar situation in the future?
- Considering this learning, I will... (Set specific, assessable goals; consider benefits and challenges involved in this plan)

Response:

In conclusion, I learned that the design process requires lots of research and trial and error before producing something truly useful for others. As engineers, it is important to consider what your client really needs along with what resources are available to you before going through with a design. In the future, I will prioritize physically testing multiple sample options and evaluating objectives to determine more accurately what the better solution would be in the given time and with the given resources.

In two to three sentences, describe the possible benefits and challenges involved in your plan.

Response:

A benefit of this plan is that the team would be able to understand the solution more thoroughly through visualizing the solution in real time. On the other hand, it would take a lot of time and resources to execute each potential solution which is difficult in this scenario.

References:

Lawson, B., & Dorst, K. (2009). Design expertise. Oxford, UK: Architectural Press.

Crismond, D. P., & Adams, R. S. (2012). The informed design teaching and learning matrix. Journal of Engineering Education, 101 (4), 738-797.