Deliverable G - Prototype II and Customer Feedback

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Introduction

The objective of this deliverable is to gauge feedback from prototype II and initialize a process to make improvements to the overall design by implementing a test plan for the third and final prototype. Through evaluating the failures and successes of prototype II, the group will be able to gauge what steps need to be taken in order for the following prototype to increase feasibility and become a more cohesive design. Feedback from the client will be taken into consideration as the third client meeting has been conducted and feedback has been gathered. An analytical and experimental model will be assembled to numerically and experimentally gather quantitative data to present. An update including target specifications, detailed design, and bill of materials will be created to cater to the changes made to prototype II following prototype I. Overall, the goal of this deliverable is to critically evaluate the second prototype through analytical models, client feedback, and experimental data in order to make educated decisions for the third and final prototype.

Client Feedback on Prototype II

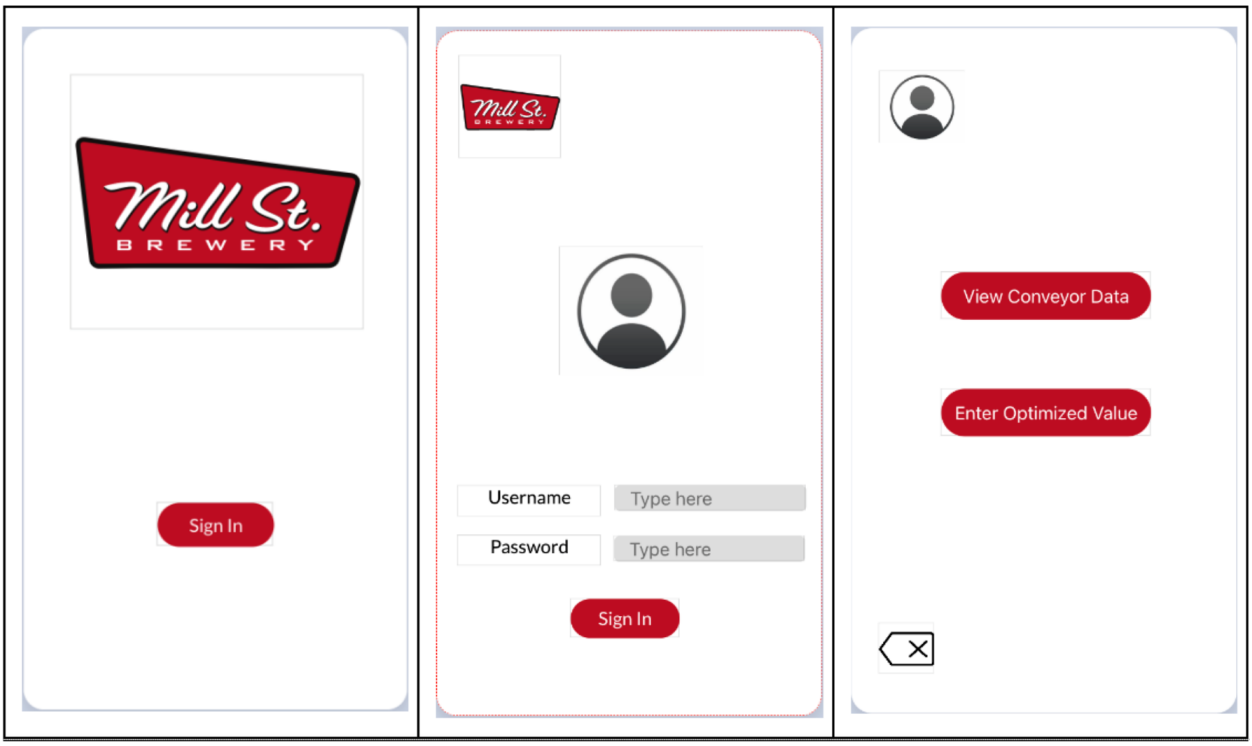
Notes from Client Meeting III:

- Client asked if we are going to track live data and how that would be implemented if we are.
    - Our answer: “we had the arduino part in our previous prototype to track live data, specifically temperature, energy, and speed. But we did get rid of it for a more easy to use application and so the design overall is more cost effective”. We came to this decision since our TA advised us that we are going to be given a file of data and it may not be necessary to have an extra hardware part of the design (the arduino bit).

- We then asked the client what his impression of the app was so far and if there is a critical component missing from the current design.
    - He answered: “the app looks great, looks very easy to use, the possibility of having that data tracked would be nice, the temperature and energy is secondary at this point although it might be useful in the future but as of now it would be good to just focus on speed and efficiency”.
- We asked the client, “since the speed will have to increase gradually, what are the intervals of speed the conveyor can increase at a time?”
    - The client answered: “I will forward some information in the team's chat”. (This will be helpful to us for prototype III).

Prototype II

Images



Notifications

Change Password

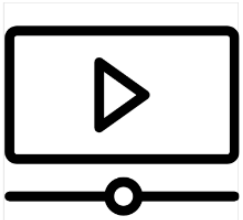
Username Type here

Confirm username Type here

Password: Type here

Confirm password: Type here

Save changes



Please enter the optimal volume of product that you would like to be produced

Enter a value

Enter

Input Data

Palletizer

Case Packer

Labeler

Pasteurizer

Filler

Empty Bottle Rinser

Depalletizer

Palletizer Optimal Values

Temperature

Minimized =< **Optimal** =< Maximized

Energy Usage

Minimized =< **Optimal** =< Maximized

Speed

Minimized =< **Optimal** =< Maximized

Case Packer Optimal Values

Temperature

Minimized =< **Optimal** =< Maximized

Energy Usage

Minimized =< **Optimal** =< Maximized

Speed

Minimized =< **Optimal** =< Maximized

Labeler Optimal Values

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Energy Usage

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Speed

Minimized =< **Optimal** =< Maximized

Pasteurizer Optimal Values

Temperature

Minimized =< **Optimal** =< Maximized

Energy Usage

Minimized =< **Optimal** =< Maximized

Speed

Minimized =< **Optimal** =< Maximized

Filler Optimal Values

Temperature

Minimized =< **Optimal** =< Maximized

Energy Usage

Minimized =< **Optimal** =< Maximized

Speed

Minimized =< **Optimal** =< Maximized

Empty Bottle Rinser Optimal Values

Temperature

Minimized =< **Optimal** =< Maximized

Energy Usage

Minimized =< **Optimal** =< Maximized

Speed

Minimized =< **Optimal** =< Maximized

Depalletizer Optimal Values

Temperature

Minimized =< **Optimal** =< Maximized

Energy Usage

Minimized =< **Optimal** =< Maximized

Speed

Minimized =< **Optimal** =< Maximized

Prototype Test Plan II Results and Analysis

Objective	Stopping Criteria	Unit of Measurement & Acceptable Fidelity/Simplifying Assumptions
To test if the functionality of the system is sufficient to deliver alerts and notifications to potential users.	In order to test if the appropriate notifications can be made in regards to specific systems, files will be input into the system and then evaluated. If an accurate reading can be created each time a new input file is entered, then this test will be deemed successful.	• **Unit of Measurement**: test cases regarding file uploads and accurate information provided. • **Fidelity:** The exact nature of the information provided is unknown (i.e. exactly how large or small the values for speed/energy/temperature are).
Results and Analysis: The information provided by the client was sufficient in testing how the app will potentially handle data given files that contain information for speed, temperature, and energy consumption. As per the client's request, speed was the main component that was focused on as this information was being tested for rate of input and accuracy of output. In order to ensure that the information delivered to the app was operating optimally without any delay, the temperature and energy consumption information for each machine was given less priority. The tests conducted were successful in producing results that conveyed that the app was able to handle real examples of information given the magnitude and frequency at which the information was being delivered to the system. The results of these tests were evaluated by whether the notification delivered to the user was accurate based on the information delivered to the system by the information files. This test also allowed for different real-world scenarios to be tested. For instance, in one test case, two machines had their optimal speed values fall out of the optimal range of values which is a very likely real world event. Upon conducting this test, the app was able to deliver the notification that both machines were not performing optimally in a sequential manner without obstructing the other notification that was delivered. The smooth transition of one notification leading to the next was deemed successful as it gave the user ample time to respond to both machines not performing optimally. Overall, this test was successful as it was not only able to prove that the app was able to handle the appropriate bandwidth of information being delivered at a frequency similar to that in a real-world instance. Additionally, the app was able to demonstrate its ability to handle unexpected real-world scenarios without sacrificing the functionality or design components of the system. To conclude, the test cases handled in this test were successful in demonstrating the app's functionality.		
To verify user perception, readability, and usability from a potential user.	In order for this criteria to be fulfilled, another potential user will be interviewed. Rather than having them go through the app themselves and speak aloud as they do so, they will be asked pointed questions regarding the interface and functionality of the app. This test will be seen as successful if the user is able to navigate through the app and provider both positive and constructive feedback.	• **Unit of measurement**: User provided overall rating /10 (1 being unsatisfactory, and 10 being excellent) • **Fidelity**: The user that we will be interviewing is not an employee of a brewery, rather someone that has familiarity with the technology used within a brewery. As a result, they may not have total knowledge about the machines used in the packing lines. This fidelity will be considered upon interpreting the results.
Results and Analysis: In this tst case, the finalized prototype II was taken to a potential user and the user was then asked to relay their thoughts about the appa aloud as they navigated through the system. The interviewer remained silent as the user relayed their thought process, only		

prompting questions when the user became quiet. Afterwards, a series of questions were posed to the potential user as to gain more insight into their opinions about the app, particularly, what they found to be positive aspects and negative aspects of the system and how we would be able to improve overall. The potential user that was interviewed as a part of the staff who works at the Mill Street Brewing Company in Ottawa. Their overall impression of the app was a 9/10. Particular positive aspects of the app that were emphasized included the user-friendly interface, the fact that a tutorial page was added to the system in order to help acclimate new users to the app, and the fact that it took very few clicks in order to get to the most critical subsystems of the app which include of the optimized speed, energy, and temperature values for every machine along the production line. The potential user deducted a point as there were some key subsystems missing that were taken into careful consideration, and will be implemented in the following prototype. These missing pages of the app include:

- The notifications settings
- Examples of what notifications would look like when delivered to the user (auditory and visual queues were determined to be the most effective in garnering the attention of the user)

Besides these features, the potential user was satisfied with the overall product, in particular, citing its user-friendly interface and the accessibility that it provides to all employees who operate and maintain the production line. Overall, the user rating awarded to prototype II for its ability to function as an operational and analytical system, as decided by a potential user, was 9/10, therefore allowing this test to be considered successful.

To test if the system is capable of interpreting, analyzing, and outputting the appropriate value and alerts to a potential client given multiple inputs within a short period of time.	The rate of input that the app will be receiving is currently unknown. As a result, the app will be put through a series of tests that evaluate its ability to accurately gather and interpret data that is incoming at an irregular rate. This will be done through providing the app with a series of files within random intervals. At first a few hours between file upload will be made. Then, the time will be reduced and the system will be evaluated on its ability to handle the flow of incoming data. This test will be deemed successful if all file uploads have been evaluated and interpreted by the app successfully.	• **Unit of measurement**: the amount of test cases passed. • **Fidelity**: the rate at which the information of temperature, speed and energy consumption is given to the system is currently unknown. As a result, it will be difficult to gauge the exact volume of incoming information that the system will have to handle at a time.

Results and Analysis:

This test is similar to test I where the system was given files and evaluated on its ability to output the appropriate notifications and information given these files. This test, however, regards how far these capabilities can be pushed when attempting to replicate a real-world scenario. For instance, if the sensors implemented in the floor of the brewery detect that multiple machines are not operating at optimal capacity, causing a domino effect in which one machine not performing optimally leads to the next machine not performing optimally, and the next, then this test was conducted to see how the app would handle a scenario such as this. In order to closely replicate this scenario as much as possible, multiple files were taken from the client and altered so that the information within them would indicate that multiple machines were not functioning at an optimal rate. In test I, only two machines were supposedly not performing at optimal rate as per the information in the file. However, this test case exhibited multiple functional errors with the first starting with a machine further up on th reproduction line, and the rest of the machines proceeding it following with their own functional errors. These test cases were more unsuccessful as the magnitude of notifications that were needed to be sent to the user was much higher than that of the notifications being sent in test I. When this test was being conducted, the system failed to deliver the appropriate amount of notifications to the user as the system would crash and refresh, ultimately purging the information it had received from the files. As a result of this test case, it has been determined that the system requires a more sophisticated method of delivering notifications to the user should a certain selection of the production line have a functionality error. This will be addressed in future prototypes with potentially expanding thee bandwidth of information that can be handled by the system, in addition to altering the way in which notifications are delivered.

Analyzing if the optimal values are appropriate	In order to effectively analyze if the optimal value functions are running properly, multiple test cases will	• **Unit of measurement**: test cases constructed by the group members

given different inputs.	be provided in the form of different files containing different information about each machine on the production line. In these tests, the machines will have data that corresponds to the machine's speed, temperature, and energy consumption. In each test case, a different machine will exhibit values that are either below, or exceed the optimal value calculator by the app given the user input. The system will have passed the test cases if a notification is given to the user corresponding to that specific machine, and if the notification is accurate. Ex. "Pasteurizer temperature is above optimal value, please attend to this machine immediately."	in .txt or .csv files. • **Fidelity**: The values provided in the files will not be as accurate to the values that are seen in a real tst using real brewery data as we are unsure of how much fluctuation there is with the values. Therefore, these optimal values may be significantly higher or lower depending on the user input we provide.
Results and Analysis: This test involved evaluating if the calculations regarding the input value for the optimal volume of product was appropriately corresponding to the information being input to the system by the files given to us by the client regarding their machine operations. The system being tested was the subsystem where the user enters their optimal value of product they would like produced when prompted. Upon being given this value in addition to the speeds, temperature, and energy consumption of that specific machine from the file, an appropriate optimal range was calculated and delivered once the user selected to see the optimal range of values. Unfortunately, the calculations that were put in place to combine the input rates as well as the user input were unsuccessful in producing a range that was realistic in a real-world example. In order to mitigate this issue, the calculations used to calculate the optimal range of values will be reevaluated and then reassessed in future prototypes.		

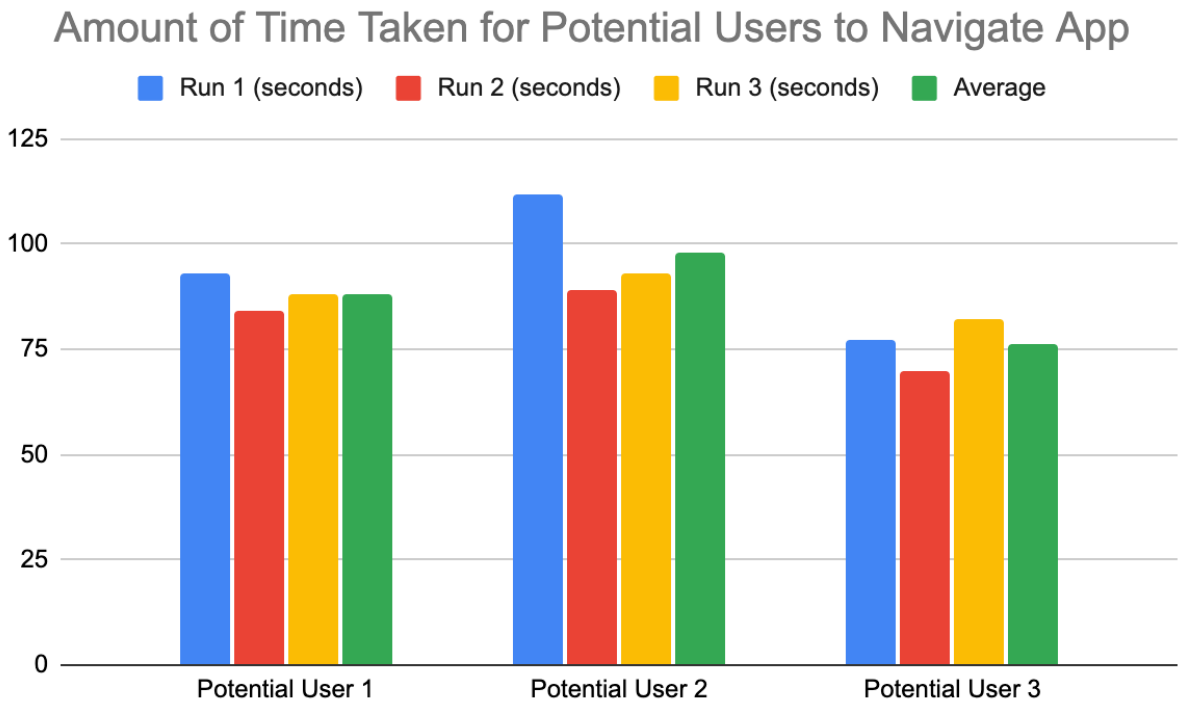
Analytical and Experimental Model

Analytical Model

In order to construct an analytical model to test user perception of the interface, three potential users were asked to navigate to certain pages within the app. This produced a cohesive analytical model that demonstrates that the system is functional in its ability to exhibit valuable information to users within the shortest amount of time possible.

Table 1. Tabulated Raw Data demonstrating Analytical Data for User Navigability

	Run 1 (seconds)	Run 2 (seconds)	Run 3 (seconds)	Average
Potential User 1	93	84	88	88.3
Potential User 2	112	89	93	98
Potential User 3	77	70	82	76.3
Overall Average				87.5



Experimental Model: Feedback from Potential Users

1. **How user-friendly and easy to navigate did you find the app to be?**
- I found the app to be extremely user-friendly and easy to navigate. Everything is well-organized and logically laid out, which makes it easy to find what I'm looking for.
2. **What do you think about the design of the app?**
- The design of the app is visually appealing and modern. It looks great and is very easy on the eyes.
3. **How fast and responsive is the app?**
- The app is very fast and responsive, with minimal lag or loading times. I'm impressed with how smoothly it runs.
4. **Are the features of the app well-organized and logically laid out?**
- Yes, the features of the app are well-organized and logically laid out. It's easy to find what I need and everything is clearly labeled.
5. **Is the app reliable and does it crash or freeze frequently?**
- The app is very reliable and I haven't experienced any crashes or freezes. It's a pleasure to use.
6. **Does the app integrate seamlessly with other devices and services?**
- Yes, the app integrates seamlessly with other devices and services. It's very convenient and makes my life easier.
7. **How well does the search function work?**
- The search function works very well and provides accurate results. I'm always able to find what I'm looking for quickly and easily.

8. **Are the notifications helpful and informative without being intrusive?**
- Yes, the notifications are very helpful and informative without being intrusive. They keep me up-to-date without overwhelming me.
9. **How do you feel about the app's security features?**
- The app's security features make me feel safe and protected. I trust that my information is being kept secure.
10. **Have you had any experiences with the customer support team? If so, how was it?**
- Yes, I have had some experiences with the customer support team and I found them to be responsive and helpful. They were able to resolve my issue quickly and efficiently.
11. **Do you find the app provides useful and relevant information?**
- Yes, the app provides very useful and relevant information. It's a valuable resource for me.
12. **How do you feel about the app's customization options?**
- I love the app's customization options! They allow me to tailor my experience to my preferences and make the app feel like it's personalized just for me.
13. **Have you noticed any new features or improvements added to the app?**
- Yes, I've noticed that the app is regularly updated with new features and improvements. It's great to see that the developers are always working to make the app better.
14. **Is the app's performance consistent across different devices and operating systems?**
- Yes, the app's performance is consistent across different devices and operating systems. It works just as well on my phone as it does on my computer.
15. **How do you feel about the app's value proposition and pricing?**
- I think the app's value proposition is clear and its pricing is fair and reasonable. I feel like I'm getting a great product for a reasonable price.

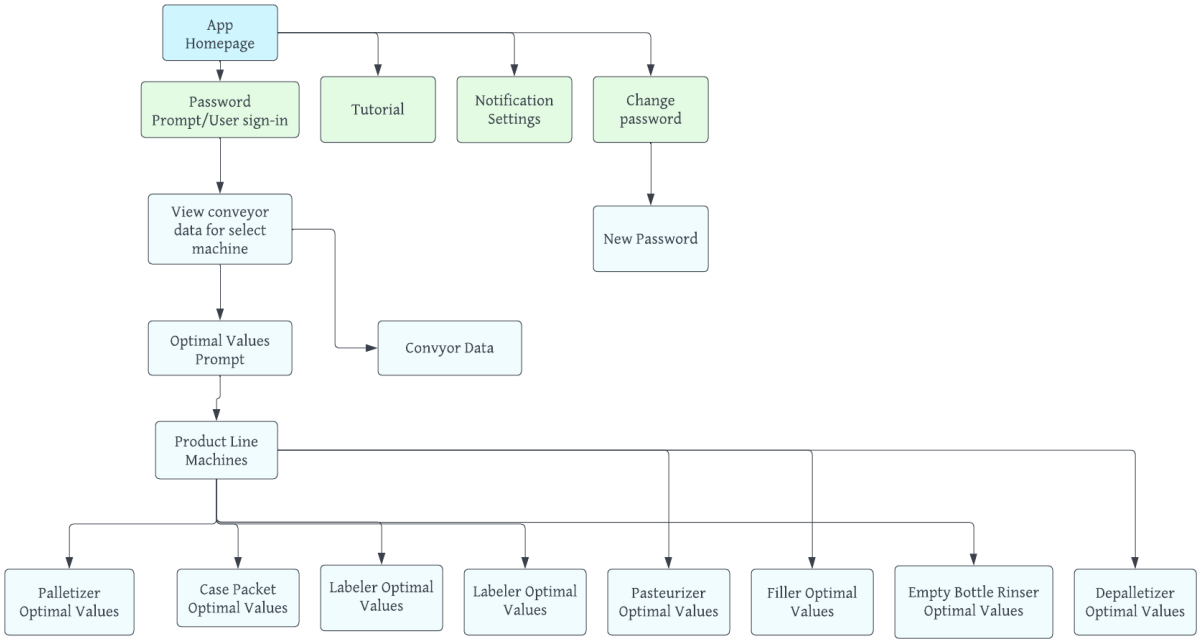
Updated Design

Updated Target Specifications

- User Needs Statement (Derived during Deliverable B):
    - There exists a need for the Mill Street Brewery Company to increase production speed by 2% across all machines by implementing a device that is able to identify stations that are not performing at optimal rates, make recommendations for these stations, and provide accurate real-time operational analyses of energy consumption, production output, and equipment performance.
- After our group's pitch presentation with the client during client meeting III we were able to solidify the target specifications that we will continue to showcase in our design. The list below identifies what important user needs we need to continue incorporating on our final prototype just as well as we incorporated them into our second prototype (in this deliverable).
    - App should continue to be user friendly.
        - Prototype III should have the completed tutorial tab,

        - Getting the analyzed data after inputting optimal rates should still be done with very few clicks in prototype III.
        - One username and password and only the admin being able to change that information seems most beneficial compared to each employee having their own username and passwords.
            - We will continue this in prototype III.
    - In prototype III we will continue to consider the bottle line, keg and can line separately. In fact, we are going to continue to showcase that every single machine is considered individually since all 7 machines in our current prototype are located separately on the app.
- The list below identifies what target specifications should be implemented in prototype III based on the insightful feedback we got during client meeting III.
    - The client started off by asking us if we were going to track live data and how our design would implement that. Later, when we asked the client what his impression of our prototype was, we understood that the client *does* actually prefer having a design that tracks live data.
        - To implement this into our design for prototype III, it would be best that as we work on the prototype we attain lots of feedback every step of the way to make sure we are effectively using the arduino bit to analyze live data.
        - It would be helpful to continue to ask TA's our arduino based questions as well as using MS teams to chat with the client for more specific project based questions we have. Additionally, we can ask outside sources for feedback (other breweries close by, individuals who used to/currently works at a brewery, etc.).
        - We would also need to change the design of our app accordingly, the main concept should not change much.
    - The client mentioned our main focus should be just speed and efficiency at this time.
        - In prototype III it would be best to get rid of the temperature and energy analyzing aspects of the app. Which would essentially make a more user friendly/target specified application.

Updated Detailed Design



Updated Bill of Materials

Material	Cost
Thunkable (Free Plan)	$0

Prototype III Test Plan

Objective	Stopping Criteria	Unit of Measurement & Acceptable Fidelity/Simplifying Assumptions
To gauge user perception of the overall app.	For the third and final prototype, it is essential that user perception of the overall system is positive. The test that will be conducted to evaluate this component will consist of an interview with a potential user that has been engaged throughout the entirety of the prototyping process. An appropriate stopping criteria for this component will consist of a short survey given to the user. If the user rating is above 70% by the time survey results are given, then the stopping criteria will be deemed to have been successful. This test will evaluate mainly non-technical components such as the aesthetic of the system, and overall functionality. The user will be given time to look over and navigate the app before being given the survey.	• **Unit of measurement**: The user's overall rating of the app collected via the survey. • **Fidelity**: This is the third and final prototype of the systeem, and therefore, it should be fairly similar to that of the final product, therefore there should be very little fidelity. Considering that the app is being tested by an employee of the Mill Street Brewery, this test should very closely resemble the impression of another employee.

To analyze the input of information and how the system is able to handle different volumes of information for different machines.	This test will analyze how the input of information into the system is taken, and processed. The efficiency of this intake of information will be tested based on how the app is able to deliver an accurate notification output given certain file inputs with varying information that indicates that different machines are not operating at optimal capacity. This is a continuation of test II from the prototype II test plan in which the test had failed as a result of the sheer magnitude of information that had to be output. In order to circumvent the same outcome, changes will be made to the overall method in which the system takes in, and outputs information.	• **Unit of measurement**: the amount of test cases passed. • **Fidelity**: The frequency of information being passed to the system is still unknown and will have to be verified with the client. Until then, the system will be receiving information at a consistent rate which may be different in a real-world instance in which information will be passed to the system sporadically.
To analyze the integration of all subsystems within the app.	This test will analyze how all the systems in the app will work together to create a cohesive product. This is a continuation of prototype II test III. This test was unsuccessful as the calculations that are implemented to connect the user-entered optimal amount of product they would like to be produced during that day and the input of the files for machines regarding their speed/temperature/energy consumption were not compatible. In this test case, the calculations will be reviewed and reevaluated to create an equation that is able to produce an optimal range of values. The stopping criteria will be when the values create a reasonable range of values for the temperature, speed, and energy consumption to fall under, as verified by the client.	• **Unit of measurement**: range of optimal values. • **Fidelity**: The files provided by the client with the information regarding energy consumption, temperature, and speed increase the fidelity of this test exponentially, so there is very little deviation from this test with comparison to the actual test real-world implementation of this system.

Wrike Snapshot

https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=3IUiYetEmAqdnAkOXb944ZJbJUf4QCgu%7CIE2DSNZVHA2DELSTGIYA

Conclusion

In short, feedback received from the client on the first prototype has been carefully outlined and used to inform future design choices and improve the solution. The prototyping test plan, analysis, and results have been thoroughly documented, and feedback from potential clients/users have been gathered and incorporated into the design. The objectives of the prototype, including communicating and getting feedback for ideas, verifying feasibility, analyzing critical subsystems or system integration, or reducing risk and uncertainty, have been clearly defined, including the establishment of stopping criteria. The use of an analytical, numerical, or experimental model has been used in this design. Overall, the prototype had a smaller, targeted objective with specific tests and measurable results, and had been updated based on the feedback and test results obtained. The outlined prototyping test plan will prepare teams to build

the second prototype in the next deliverable, with a focus on achieving the testing objectives and defining acceptable fidelity based on the prototype's objectives.