Deliverable F - Prototype I and Customer Feedback

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Client Feedback

We created a list of questions that go hand in hand with our presentation from the first one on one client meeting our ground had. Through these questions and the client asking us questions throughout the presentation it self, we acquired the following feedback:

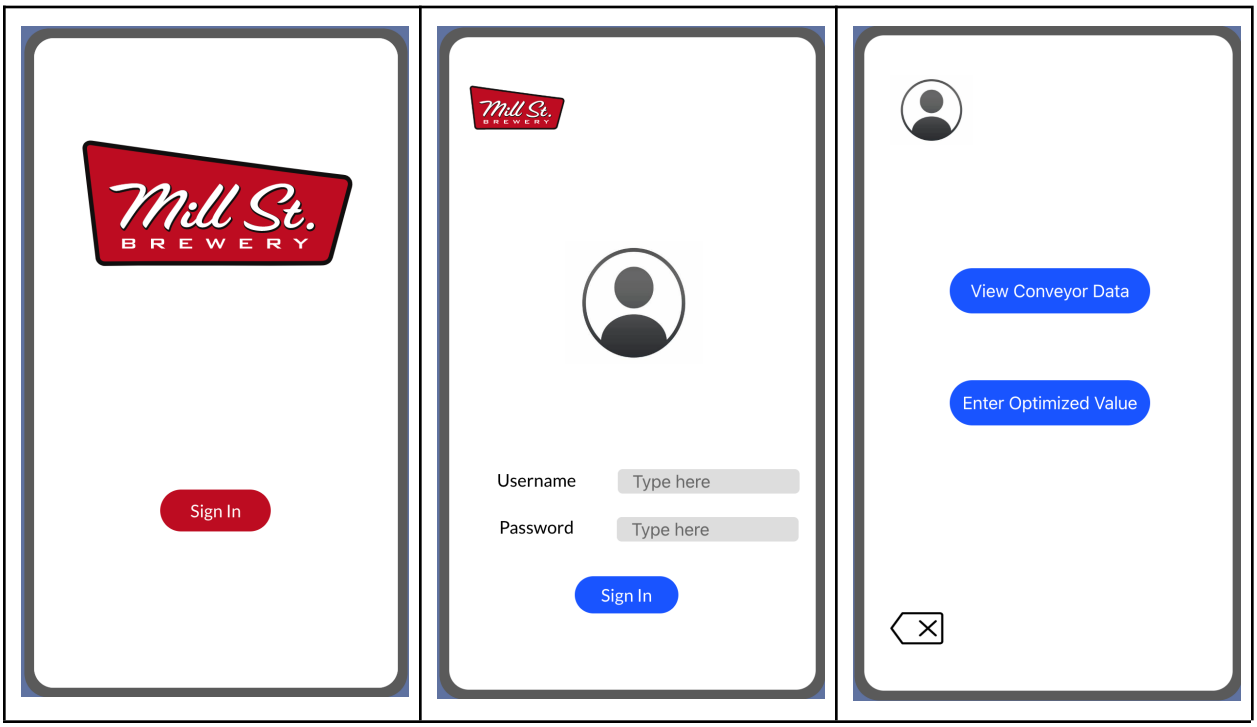
1. The client stated that in regards to how much energy is being used and how this energy is measured, hectoliters is part of the answer to that, which he states that more information will be provided soon.
    a. Our design incorporates aspects of energy, so this info should be useful to us.
2. In our design, we have a screen on the app that checks real time data where speed of the conveyor belt can be viewed and analyzed. So the client states that information on how fast the conveyors run on average is something that will be provided to us (“check back on Thursday”), he also mentions that the speed differs between the different kinds of lines. So we will have to consider the bottle line and can line.
    a. In our first prototype design, our group should consider that when the “real time data” button is clicked the user should be able to view data for the bottle line and can line, separately.

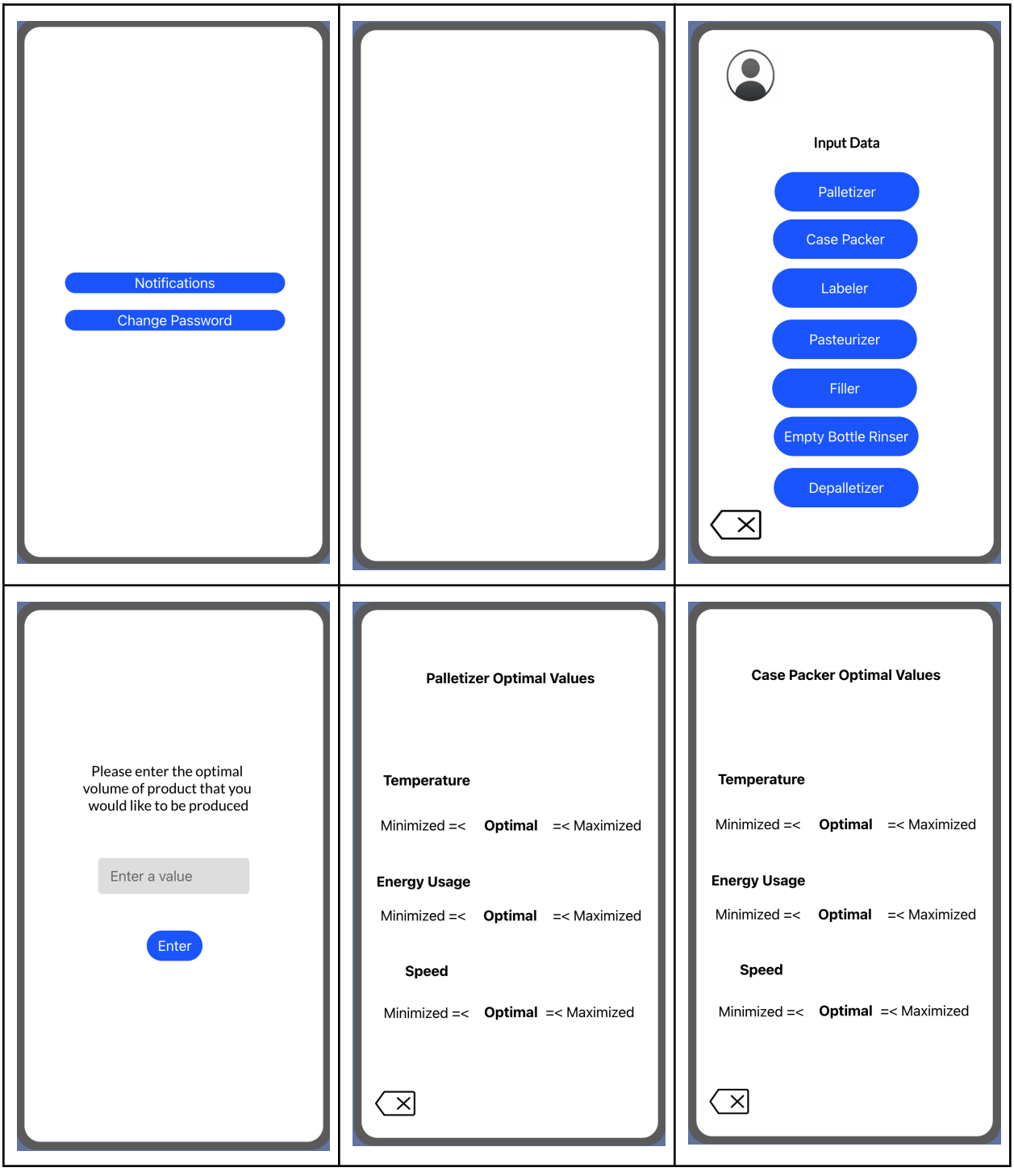
3. In our initial design, we have created app screens where all the information regarding the conveyor belt is given at once, so the client states that the user “should be able to see if a certain area is worse than others”
    a. What this means to our group on terms of design, might be to go forward with having most of the conveyor belt data on one screen, making the readability easier as the data will be easier to compare
4. In one of our questions we asked about temperature sensors and if a machine has ever overheated.
    a. The client provided us with insightful feedback as it is stated that this is not a main priority and is dealt with through maintenance checks, as well as mentioning that our focus should be on energy.
        i. This reminded us of what the main goal is and exactly what the client is looking for.
5. The client also mentions that the information provided in the app should be far from base level, meaning it should be very detailed “in terms of location”
    a. The client also states that notifications should be coming through the app so it can be viewed and dealt with right away, compared to employees having to walk around to see if a light or sound is going off (app notifications are better than real life notifications since it's easier to check and manage).
        i. We can implement this in our design, by programming a process that says for example “bottle line conveyor belt will be optimized if x (x=recommendation), head to bottle line conveyor belt and look for red flashing light to change settings” as an app notification/alert.
        ii. There should be multiple sensors on the lines for most accurate results
6. The client provided us with feedback regarding how often there are employees actually monitoring the machines and how fast they would be able to respond to an emergent alert. We asked this kind of question so we can program the app to send out notifications at an appropriate time while considering all instances.
    a. The client stated that the employees and he himself looks at the percentages every day.
    b. On a regular day, they would check most likely once in the morning and the afternoon.
    c. As for employees it is a shiftly basis, but is checked every day, 1-2 per shift.
7. We asked the client if there was a way our design could be altered to accommodate for the new innovations being added to the production line that was discussed in the first client meeting.
    a. The client stated the app should have set speed and should be easy to adjust.
    b. This way it can accommodate any changes occurring with the production line as it occurs quite frequently.
8. Towards the end of the client meeting, the client states that the overall design would include optimal outputs every time, and it should be very user friendly.
    a. In our initial design, we included a tutorial tab in the home page, for employees to learn how to use the app for a very hands-on experience. As a team we agree to keep this feature since the app being user friendly is very important to the client.
9. The client also mentioned that there should be an admin user, so that the admin can create new users for employees when the admin is not there to control the machines and the app.
    a. This can be implemented in the settings tab of design we’ve created.
    b. There are also no phones allowed, so the computers and tablets at every station should be able to run the app.
10. The client also mentioned it is important to include key performance indicators.
    a. For example, how much it costs to the run the line
    b. He provided us with feedback regarding what to think about with costs.

i. He states that it is “expensive to put power meters on every machine”. So this is something we should keep in mind when budgeting for the design and buying materials.

Prototype I

Software Prototype Images




Notifications
Change Password
Input Data
Palletizer
Case Packer
Labeler
Pasteurizer
Filler
Empty Bottle Rinser
Depalletizer
Please enter the optimal volume of product that you would like to be produced
Enter a value
Enter
Palletizer Optimal Values
Temperature
Minimized =< Optimal =< Maximized
Energy Usage
Minimized =< Optimal =< Maximized
Speed
Minimized =< Optimal =< Maximized
Case Packer Optimal Values
Temperature
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Energy Usage
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Labeler Optimal Values **Temperature** Minimized =< **Optimal** =< Maximized **Energy Usage** Minimized =< **Optimal** =< Maximized **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 	

App names

- Beer Metrics
- Brew Data
- MSData

Analysis of Critical Components

- **Input Data**

Rather than receiving input from an Arduino system that was to be implemented to all machines to monitor energy consumption, speed, and temperature, it was determined that a much more cost-effective solution was to have the client provide this information for the app to gather, process, and analyze. The client mentioned that they already have this information on files that are able to be read by the app-building software that is currently being used to construct the app. Accordingly, there is no more real-time data as all data will be entered within the times that these data files are provided to the app. This information is not yet known as the client has not provided it, but it is an essential question that will be asked in future client meetings and over Microsoft teams.

- **Optimal Values**

The optimal values pages now focus on each specific machine along the production line. It is essential that these values are accurate and apply to the specific machine that it is analyzing. A change from the initial plan is that multiple pages now focus on each specific machine. This was constructed for the purpose of providing accurate information for each individual machine rather than the system as a whole. In doing this, the information provided is unique to individual machines, allowing employees to make decisions that benefit the entire bottling process by solving operational conveyor issues with more precision.

- **User sign in**

Rather than continuing with the initial design of having multiple user profiles for every employee, it was decided that a more efficient strategy to make the app more user-friendly and efficient is to have a single profile and login information for every employee. Additionally, a single profile will be made for the admin to allow them to deliver input files into the app for employees to monitor. By reducing the amount of data and login information that needs to be stored, the app is able to run faster and therefore deliver alerts to employees at a more efficient rate.

Prototyping Test Plan, Analysis, and Results

Prototyping Test Plan I Objective and Results

Objective	Stopping Criteria	Unit of Measurement & Acceptable Fidelity/Simplifying Assumptions
To test if the temperature input system is effective gathering accurate data in real-time.	When the temperature sensor is connected to the Arduino Uno board, and when this is then connected to the Arduino IDE, a series of tests will be conducted to ensure that the program is collecting and displaying accurate real-time data. The stopping criteria for this would be conducting a simulation of the conditions that would be similar to the ones found in the floor of the brewery. If the Arduino IDE is accurately	**Measurement**: values/second, ºC/second **Acceptable Fidelity:** ● The temperatures that the temperature sensor would be reading would not be as high as the ones expected to be seen in the actual floor of the brewery. Therefore, it is assumed that a successful run will

	outputting data at a rate of a temperature value for every second, then the stopping criteria will be fulfilled and it can be concluded that this input system has fulfilled the requirements to be considered as a successful system in the prototype.	produce temperatures that are on average, lower than the ones that will be seen in the actual trials of the product.

To test if the speed sensor of the input system is effective in gathering accurate data in real-time.	When the speed sensor is connected to the Arduino Uno board and when this is connected to the Arduino IDE, the speed sensor will be put through a series of rigorous testing to ensure that the prototype is consistent with the standard required for the final product. The way in which the actual speed sensor will work is by tracking the speed of cans as they move by on the conveyor belt. As the cans move past, the sensor will track the speed at which they pass and relay this information to the arduino IDE. Once this information is being relayed back to the IDE at a rate of 1 value per second, then the test will have been successful.	**Measurement**: cans/second, m/s^2 **Acceptable Fidelity**: ● As much as the group will try to recreate the same environment for the prototype testing to take place, it will be very difficult to recreate the exact conditions. As a result, the closest simulation may be inaccurate. For instance, to simulate the motion of a conveyor belt, an escalator or treadmill may be used.

To test is the energy sensor of the input system is effective in gathering accurate data in real-time.	When the energy sensor is connected to the Arduino Uno board and when this is connected to the Arduino IDE, then the energy sensor will be put through a series of tests to gauge the efficiency of the input system. In order to attempt to recreate the conditions that would be observed on the floor of the brewery, a device will send a controlled amount of voltage to the energy sensor. The current from this device will then be recorded and displayed on the Arduino IDE. If the Arduino IDE outputs information at a rate of 1 value per second, then it will have been considered successful.	**Measurement**: Hz/second **Acceptable Fidelity**: ● It is expected that the amount of voltage being produced in a controlled environment is unable to recreate the exact conditions that will be seen in the real-world application of this device. Accordingly, an acceptable voltage will be much lower than that being used to power the machines on the floor of the brewery. If changes need to be made in order to gain a more accurate measurement for the client, then a more powerful sensor will be used.

Analysis and Results

Upon speaking with the product manager and conversing with the client, it was decided that the three parts of the prototype were no longer necessary for the final product. Hence, prototyping on this part of the design was canceled. Rather than collecting input data from the machines on the conveyor line ourselves using arduino, it was decided that gathering data using input files imported by the admin of the app would be most efficient and cost-effective. Resultantly, the app will read data gathered by sensors already collecting data from the machines and store them in either a .csv or .txt file. These files will then be read by the primary app builder that the final product will be made with. Thunkable provides a service with the paid plan in which files are allowed to be added, read from, and analyzed. This makes the prototyping process significantly less strenuous in terms of gathering materials and constructing a

comprehensive prototype. Rather than creating systems that would collect information for every machine, potentially being very cost-ineffective and troublesome for employees to navigate and monitor, it was decided that a more reasonable approach would be to have the client provide us with the information required to determine if the machines were running at an optimal level. In addition to having the app be the interface for this information to be relayed to the employees, the team will also provide some additional code written in C that reads and opens files to ensure that the program runs smoothly. Overall, without these systems, the program becomes much more simple, therefore leaving the team with more time to focus on the aesthetics, user readability/usability, and the overall functionality of the app.

To test if the system interface is user-friendly and easily accessible by people of different backgrounds.	In order to effectively test if the software being created is user-friendly, a series of user tests will be conducted. In these tests, a series of randomly selected participants will be asked to navigate through an initial prototype of the software. With their permission, they will be recorded and asked to talk about their thinking process while navigating the software. Should a participant not say their thinking process out loud, they will be prompted to by the person running the test.	**Measurement**: The amount of time that it takes for a user to navigate to certain areas of the app. **Acceptable Fidelity**: ● The people who will be asked to navigate the app are simply giving us a gauge of how user friendly the app is and may not be very well versed in the technical specifications of the product. It can therefore be assumed that they will take a longer time to navigate through the app in comparison to the employees who will have access to a comprehensive video tutorial.

Analysis and Results

In order to effectively test this prototype in terms of whether or not it exhibited a user-friendly interface and prioritized the user's ability to navigate the system, an interview with a potential user was conducted. The uOttawa campus boasts an on-site brewery in which chemical engineering students are able to apply their knowledge of chemical processes. Here, we interviewed a chemical engineering student who was asked to speak aloud as they navigated the system. An overall impression of the app was that it had a user-friendly interface that had potential to be very useful on the floor of a brewery. The student mentioned that monitoring many of the brewing systems simultaneously is difficult and provides challenges which is why this app has potential to be useful. In regards to specific subsystems on the app, the interviewee mentioned that it was troublesome to have to use the back button on the bottom left-hand corner of the screen as it was quite small. In order to mitigate this, the button was made larger to be more accessible. Another area of improvement that the student mentioned was with regards to how frequently the app would need to take in input in order to effectively alert employees of potentially unoptimized running speeds, temperature, or energy usage. As of right now, the client has not specified the frequency of updates that will be made to the files, or how frequently data will be output to the system. This is an attribute that will need to be confirmed with the client during the pitch meeting, or over Microsoft Teams. The student also mentioned that it was essential for the app to be able to be readable, clear, and precise with the information being displayed. If a system were to be dysfunctional, an employee would have to have the knowledge as soon as possible in order to react accordingly. This improvement was translated to making the app very structured in terms of aesthetic and design. In the upcoming prototypes, this improvement will be implemented by prioritizing aesthetics that promote clear conceptualization of the

information being given. In conclusion, the meeting that was conducted with the student was very informative and productive, allowing the team to understand what a potential user would require in a finalized product.

Potential Client and User Feedback

Questions Asked to Potential User

1. **Is the app user friendly and accessible to all 27 employees that use the machine every day?**

Yes, the app has been designed with a user-friendly interface and is accessible to all users regardless of their technical knowledge or expertise.

2. **Is there anything that should be improved in the BeerMetric App?**

Without access to the specific app, it's challenging to identify potential improvements. However, regular updates and improvements should be made based on user feedback and best practices to ensure the app's functionality, usability, and security.

3. **Does the app have a fast loading time?**

   Yes, the app has a fast loading time to ensure a seamless user experience and improve efficiency.

4. **Does the app have strong data protection?**

Yes, the app has strong data protection measures, including encryption, secure data storage, and access control, to ensure that sensitive data is protected from unauthorized access, modification, or theft.

5. **Was the app worth the money?**

   The app provides the functionalities mentioned, it’s a worthwhile investment, as it can provide valuable insights and enhance operational efficiency.

6. **Does the app identify the stations that are not running at optimal rates and not conforming?**

   Yes, the app provides real-time monitoring and alerts for any stations that are not running at optimal rates or not conforming to expected performance levels.

7. **Does the app make recommendations if the speed is not optimal?**

   Yes, the app provides recommendations to improve performance and optimize speed if a station is not running at optimal rates.

8. **Can the app collect data from the conveyors to provide valuable insights on machine performance and send real-time alerts to employees when issues arise?**

   Yes, the app collects data from conveyors to provide valuable insights into machine performance and send real-time alerts to employees when issues arise.

9. **Is the app harmful to the environment?**

   The app has been designed with sustainability and environmental responsibility in mind, it should not be harmful to the environment.

10. **Does the design monitor production and analyze various operations data, including energy consumption, production output, and equipment and performance?**

    Yes, the app's design monitors production and analyzes various operations data, including energy consumption, production output, and equipment and performance, to provide data-driven decision-making and continuous improvement.

Answers Provided by the Potential User

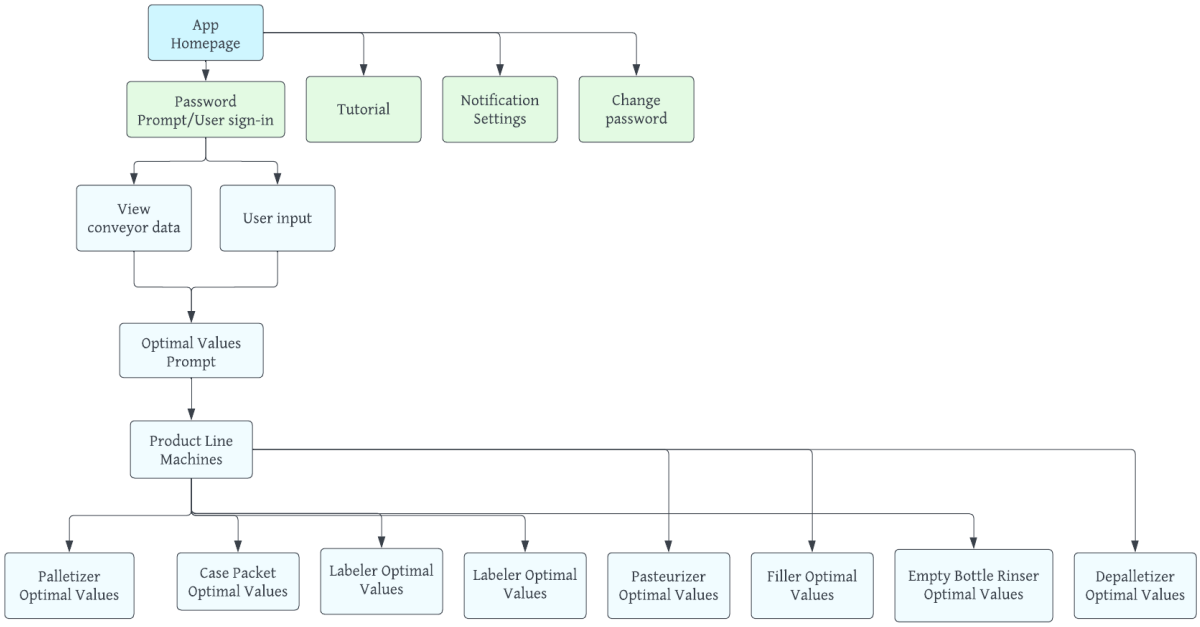
Updated Target Specifications, Detailed Design, and Budget of Materials

Target Specifications

- User Needs Statement (Derived from 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.
- From the first client meeting our group identified some user needs and what should be incorporated into the design. After our first one on one client meeting we were able to focus on which of these needs is most important and which of these needs aren't so important.
    - We identified that we are creating an app, so one of the main things we got from our client at Millstreet Brewery is that the app should be as user friendly as possible. This cut out a few of the app screens that were originally going to be part of the app. We no longer believe that each employee needs to have their own username and password which is controlled by the admin, instead the admin user would know the username and password and can share it with whichever employees they would like. This ensures a more user friendly experience when signing into the app while still being password protected.
    - In the design we showed to the client, the app was checking for real time data, but after receiving feedback, this is no longer needed. This information is already present on the conveyor belt machines, so in our updated design the app will still be able to take in inputs, and now will be able to read from stored data to analyze optimal rates.
    - Another new target specific user need is that the app will need to consider the bottle line and can line separately because the speed differs between the two.
    - We originally thought temperature/temperature sensors were an important target specific user need, but through feedback we learned that this should not be our main focus since it is maintained through maintenance checks.
        - Specifically, our focus should be on energy usage which our app does analyze so this target specification is definitely still needed.
    - The way we've designed our notification system is still important in regards to target specifications because it is detailed, specific, and is easy to spot.
- Overall our one on one meeting with the client was very helpful to us as it directed us back to the most important aspects of the application. Our group concluded a more basic design is easier to use in any workspace and allows for higher readability.

Updated Detailed Design



Budget of Materials

Materials

- Arduino Uno boards (1)
- Breadboard Kit + Wires (1)
- Temperature sensor (1)
- Speed sensor (1)
- Energy sensor (1)
- Wireless transmitter (1)

Material	Cost
Arduino Uno board	$27.95
Breadboard Kit + Wires	$26.99
Temperature sensor	$12.18
Energy sensor	$10.13
Speed sensor	$10.02
Wireless transmitter	$12.49

https://x.thunkable.com/copy/2a9ef37474302a1cc541f189c9bed5a6

Prototyping II Test Plan

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).
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.
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.
Analyzing if the optimal values are appropriate given different inputs.	In order to effectively analyze if the optimal value functions are running properly, multiple test cases will be provided in the form of different files containing different information about each machine on the	● **Unit of measurement**: test cases constructed by the group members in .txt or .csv files. ● **Fidelity**: The values provided in 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."	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.

Wrike Snapshot
https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=aAiiSRBcfF9pzN3lIv504JexOKejyt5m%7CIE2DSNZVHA2DELSTGIYA

Conclusion

In conclusion, the BeerMetric app seems to be a well-designed and user-friendly application that provides valuable insights into machine performance and enhances operational efficiency. With real-time monitoring, alerts, and recommendations, the app can identify stations that are not running at optimal rates or not conforming to expected performance levels, and provide solutions to improve performance and optimize speed. The app also collects and analyzes various operations data, including energy consumption, production output, and equipment and performance, to provide data-driven decision-making and continuous improvement. Additionally, with its strong data protection measures and sustainability and environmental responsibility, the app is a worthwhile investment that can contribute to reducing the organization's environmental impact. Regular updates and improvements based on user feedback and best practices can further enhance the app's functionality, usability, and security, making it an even more valuable tool for the organization.