University of Ottawa
GNG 1103-B00: Engineering Design

Project Deliverable E:

Project Schedule and Cost

Group members:

Alan Wang - 300140660

Christopher Al-Rahi - 300304285

Mohamed Reda Raki - 300281028

Rebecca Kimbell - 300233280

Abby Falkenham - 300324956

Table of Contents

Abstract

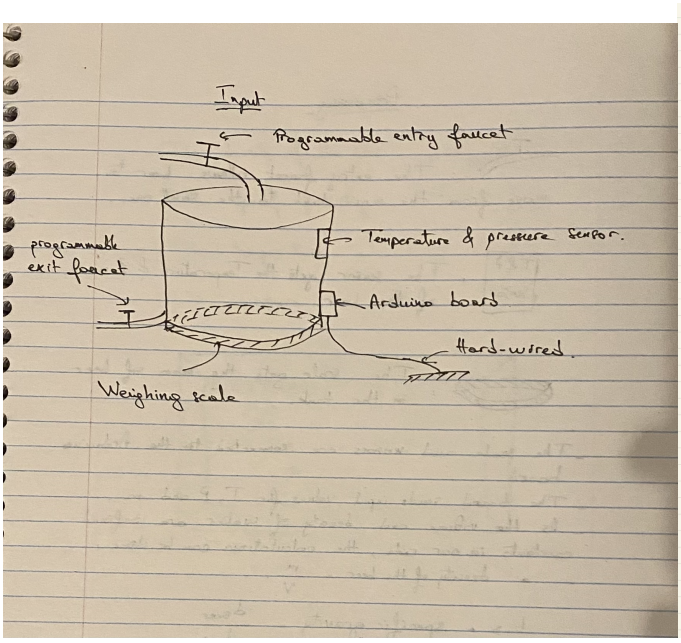
In this deliverable a clear and detailed drawing of our complete project concept was made. A bill of materials was created that listed all materials needed, their costs, and their links. A list of equipment has been created that details all materials needed for prototyping. Significant project risks were identified, and contingency plans were created to mitigate potential risks. Finally, a prototyping test plan was made to ensure our progress stays on track as we begin prototyping.

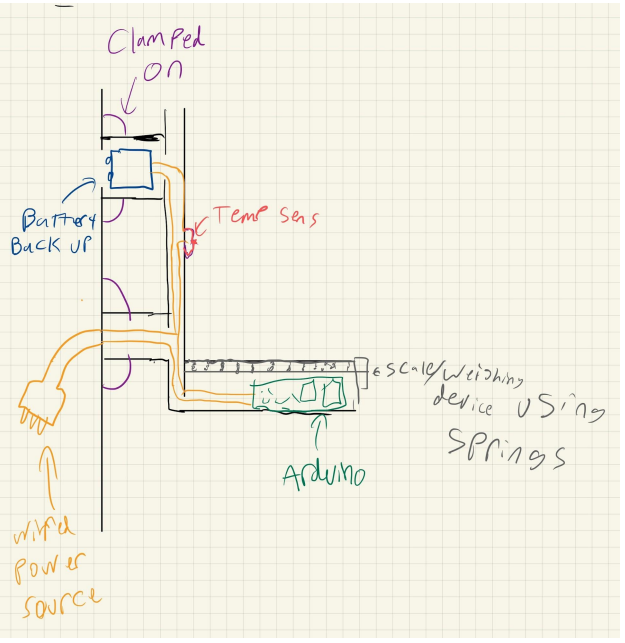
Introduction

In deliverable D, we described three different ways that we might go about making our product. After meeting with the client, we have decided which sketch we will develop further. The purpose of this deliverable is to create a project schedule. We will make a detailed design graph, a list of equipment we are going to use and the cost, a table of potential risks, and our contingency for them. In the end, we will update our outlined prototyping test plan.

Product design concept

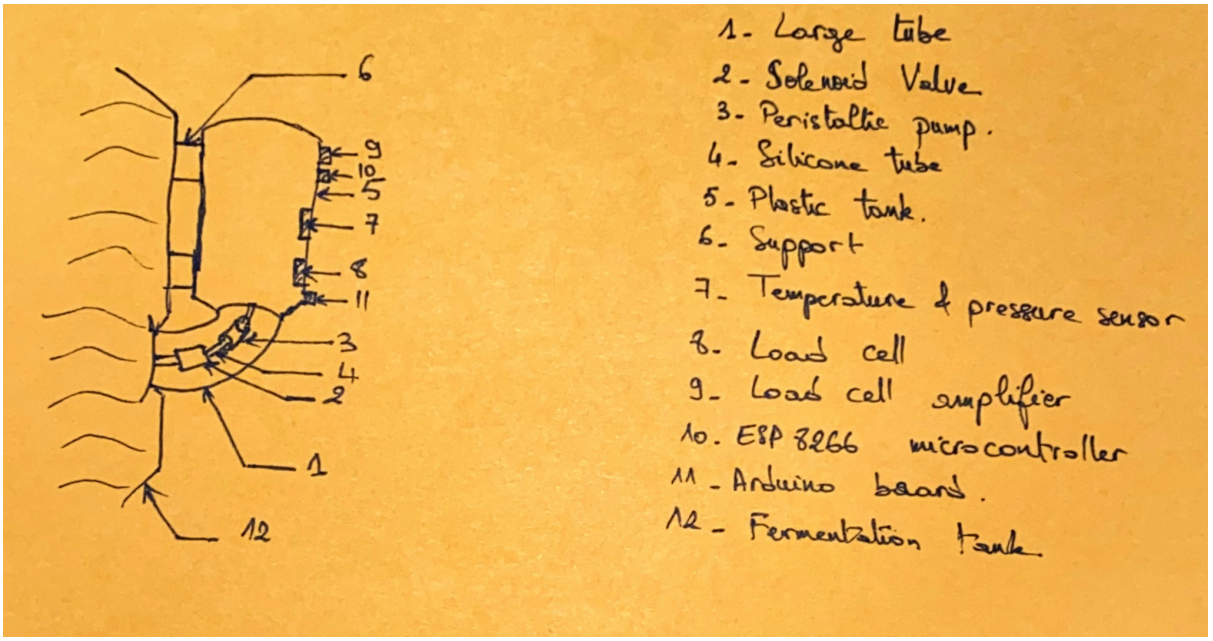
Original Sketch





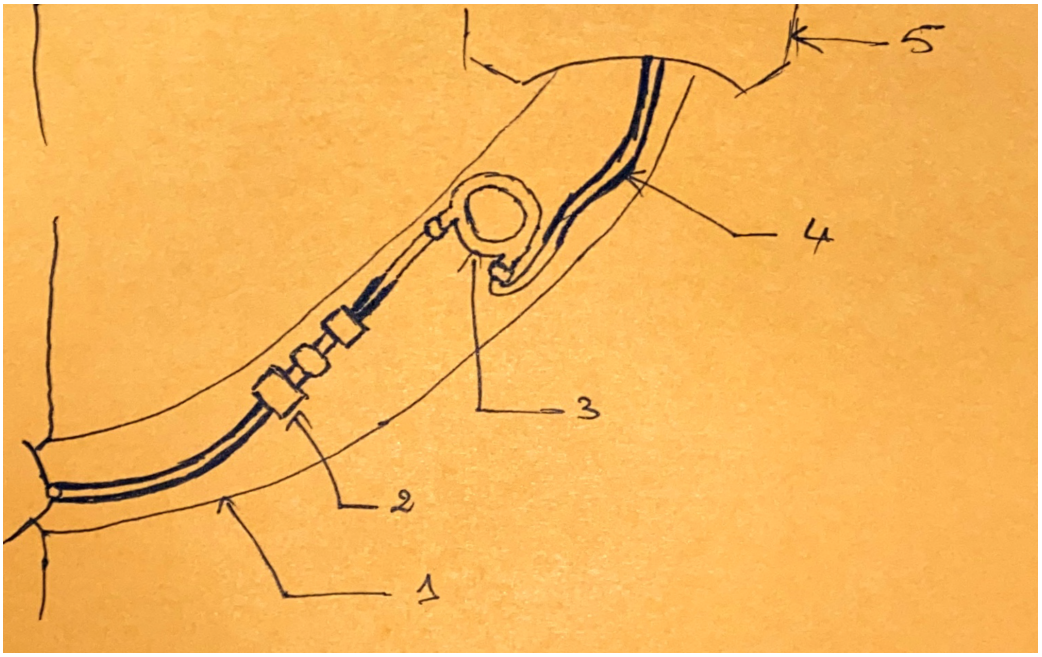
After our meeting with Shane, we decided to pursue Mohammed's sketch of the final design being a tank placed on the outside of the fermentation tank and connected with tubes along with Chris' design of the input systems.

Improved Overall Sketch



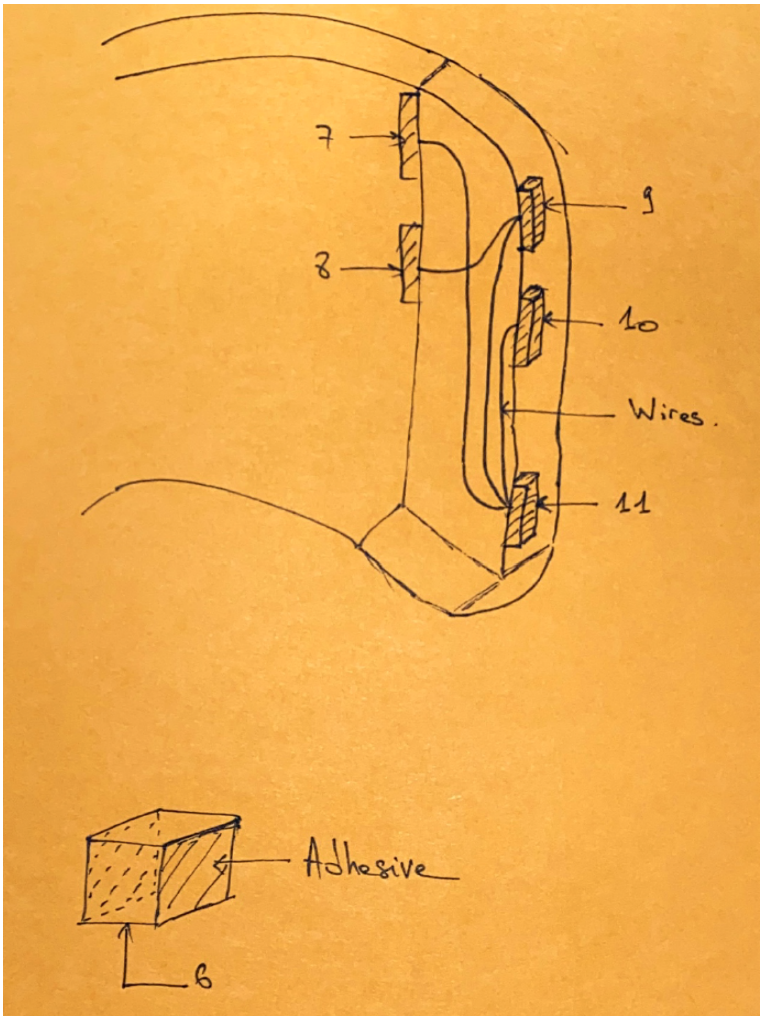
The improved device is a side tank that is attached to the main tank using adhesive blocks. The beer is transferred between tanks so the specific gravity can be calculated, then displayed using Loki Database and Grafana Cloud.

Subsystem 1 - Valve & Pump



The two tanks are connected using silicone tubes. The transfer of beer happens thanks to a valve that opens and closes the tube and a pump that controls the flow of beer into and out of the side tank.

Subsystem 2 - Sensors and wiring



The temperature and pressure sensor as well as the load cell are mounted inside the side tank, which has a completely isolated hollow part on the side for easier wiring. The temperature and pressure sensor is directly connected to the Arduino board, whereas the load cell is connected to the load cell amplifier first, which increases the accuracy of the mass values that are later sent to the Arduino board. We are also using an ESP8266 Microcontroller to connect the device to WiFi.

Bill of Materials

Software				
Part Name	Description	Quantity	Cost	Link
Grafana Cloud	Graphing software to store and display specific gravity data.	1	Free	https://grafana.com
Arduino IDE	Software to write and compile code, and send it to the Arduino board.	1	Free	https://www.arduino.cc/en/software
Loki Database	Log aggregation system compatible with Grafana.	1	Free	https://go2.grafana.com/loki-grafana-cloud.html?src=ggl-s&mdm=cpc&camp=nb-loki-exact&cnt=124221004773&trm=loki%20logs&device=c&gclid=CjwKCAjwzNOaBhAcEiwAD7Tb6GpkK0YEkuayB652eGiV-iTgVFy0Mkt3tsTkVhGLsFbBQXF4Gm13ehoCoo0QAvD_BwE
Hardware				
Part Name	Description	Quantity	Cost	Link
ESP8266 Microcontroller	Microcontroller that connects to wifi.	1	$12.99	https://www.amazon.ca/KeeYees-Internet-Development-Wireless-Compatible/dp/B07PR9T5R5/ref=sr_1_5?crid=2LV48LUWMQ34C&keywords=esp8266&qid=1666564261&qu=eyJxc2MiOiI0LjkzIiwicXNhIjoiNC4wNyIsInFzcCI6IjMuNzYifQ%3D%3D&sprefix=esp8266%2Caps%2C120&sr=8-5
Load Cell	Measures the weight of the substance and converts to electrical current.	1	$5.00	https://edu-makerlab.odoo.com/shop/product/body-load-cell-weight-strain-sensor-21?search=Load+cell#attr=
Load Cell Amplifier	Increases the strength of signals from the load cell.	1	$10.00	https://edu-makerlab.odoo.com/shop/product/sparkfun-load-cell-amplifier-8?search=Load+cell+amplifier#attr=
Temperature and Pressure Sensor	Measures Pressure and Temperature of the Beer	1	$8.95	https://edu-makerlab.odoo.com/shop/product/barometric-pressure-temperature-altitude-sensor-137?search=temperature+#attr=

Product				
Part Name	Description	Quantity	Cost	Link
Silicone Tubling	Tubing to transport fermenting beer to and from the side tank.	1	$9.48	https://www.amazon.ca/**Easter-Promotion-Month】**-Transparency-Bioengineering/dp/B08RJ8HNT2/ref=zg_bs_12572497011_sccl_8/130-6880706-4331446?pd_rd_i=B08RJ8HNT2&th=1
Peristaltic Pump	Controls flow of beer into and out of the side tank.	1	$15.00	https://edu-makerlab.odoo.com/shop/product/peristaltic-pump-77#attr=
Solenoid Valve	Electronically controlled valve to open and close tube.	1	$15.00	https://makerstore.ca/shop/ols/products/plastic-water-solenoid-valve-12v-12-nominal
Plastic Tank - Polyethylene terephthalate (Buying in-store)	1.5L tank where measurements will be taken, and sheet to go overload cell and create scale.	1	Around $30.00	
Subtotal Cost: $76.42				
Total Cost: $86.35 (Excluding tank, until the exact cost is known.)				

Prototyping Equipment

Our prototype will be adding colored water into a water bottle that is being stirred through a syringe from the side of the water bottle. This will mimic the pump adding the beer to the closed system which will be the water bottle.

Prototype			
Part Name	Description	Quantity	Cost
Water Bottle	Subbed in for the Fermentation tank	1	Free
Water Colouring	Used to color second liquid	1	Free
Syringe	To add colored water into water bottle	1	Free

Risk and Contingency Plans

This section will focus on outlining the risks that could happen during this project, and what our contingency plans are to solve them. These risks include software and hardware problems and troubles with group members. We are going to analyze them according to their probability of happening and their impact on the project. Our contingency plans for group members will be based on the contract group members have signed before. For developing a solution for problems within the input or processing of the system, we will create prototypes and figure out how dire the potential problems may be to our product and how to solve them.

No.	Risks	Probability	Impact	Contingency
1	Team members can't complete task	Low	High	The rest of the team members need to do the job
2	Group conflicts	Low	High	Work together to solve it.
3	Lost our data	Low	High	Find the data in the logs or fix the code to make sure it won't happen again
4	Lack of time to finish work	Mid	Mid	Complete early, set a required time period to complete them
5	Bug in the program	Mid	High	Fix it / ask for help if you can't find it
6	Members don't have the same meeting time	High	Mid	Split work and do it separately. Make virtual meetings more flexible.
7	Product pump forms gas and bubbles that may affect the formation of the beer	Mid	High	Develop a prototype to see how a liquid will react to having a substance pumped into it.
8	Weight measurement may be inaccurate due to the continuous flow of the liquid	High	High	Have the product refill every five minutes to have the beer still during the time of the measurement.

Detailed Contingency

1. If a member is overwhelmed with work or sick and couldn't finish the work. Other members need to figure out a way to finish his/her job. If this situation happens too often, according to the contract, we need to contact the TA and professor.

2. While members are having conflict. Others need to be calm and make sure the situation won't get worse. Later, everyone in the group needs to work together to figure a way out.
3. If our data was lost in an unexplained event. We need to find the historical saving from the cloud. Also, we need to check the code and find out why the data was lost, what bug caused this and how we fix it?
4. It is possible that we don't have enough time to finish the project. If that situation does happen, we need to ask for help from TA which requires more time. Also, we could start to do our work earlier to avoid this situation from happening.
5. Bugs can be very common in programs. In case there is a bug within the code, we would need to compile the program each time before handing it in. If the bug is not fixable, we will ask for help from the TA or professor.
6. There is a great chance that we don't have the same free time to meet. Using social media or meeting virtually could make time management easier.
7. While trying to pump the beer out of the fermentation tank, the foam will be formed causing foam to be formed within the fermentation tank, to check the severity of this risk, a prototype will be developed using colored water that is pumped into a container with water.
8. Our product is designed to have a pump that will continuously pump beer out of the product and take beer from the fermentation tank, this will cause the continuous change in beer to make our weight measurements inaccurate so instead, our solution is to have the product only pump the beer out of the tank every five minutes. This will allow us to record the average weight in between those five minutes when the beer is completely still.

Prototyping Test Plan

Test ID	***Task***	***Description of Prototype used and of Basic Test Method***	***Description of Needed Results***	***Due Date and Duration***	***Owner***
1	Project Schedule and Cost: Deliverable E	N/A	Prototype Plan	October 23, 2022, 7 days	Everyone

2	Research Completed for Overall Project	N/A	N/A	October 31, 2022 7 days	Everyone
4	Prototype I and customer feedback (deliverable F)	Use cheap materials to test the pump. Might use a cup and some kind of mini pump.	Test to find if the pump used will cause foaming of the beer, physical prototype	November 6, 2022 7 days	Everyone
5	Prototype II and Customer Feedback (Deliverable G)	most critical subsystem verifying feasibility	To see if most critical subsystem design will work before putting everything together	November 13, 2022 7 days	Everyone
6	Prototype III and Customer Feedback (Deliverable H)	comprehensive prototype	fully functional version of solution	November 27, 2022 14 days	Everyone
7	Design Showcase Presentation (Deliverable I)	Full design	N/A	November 30, 2022 14 days	Everyone
8	Final Presentation (Deliverable J)	N/A	N/A	December 1-3 2022 4 days	Everyone
9	User Guide (Deliverable K)	N/A	N/A	December 7, 2022 7 days	Everyone

Conclusion

This deliverable allowed us to clearly visualize what our product would look like and how it would work. We managed to create a clear and detailed drawing of our product which allowed us to plan further ahead and create possible risks of what could cause our product to malfunction. These risks led us to create potential prototypes which will lead us to our next deliverable and have us better set for future projects. Furthermore, we managed to estimate the cost of our product which ended up being slightly below the budget ($86.35/$100) and succeeded in finding where and how we will obtain each part needed. This was essential because it helped us find the best possible parts needed within the price range allowing us to make the best possible product with the money provided. Finally, This deliverable helped us see what we must do in our future deliverables more clearly.

Wrike

https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=7aHku5svZAqCEGGrHl2xDwA2lBMtobTV%7CIE2DGNRTGEZTMLSTGE3A
👆this link is to snapshot

https://makerepo.com/noormadhoun/754.b8-gng-1103-ar-construction-project-united-inc