University of Ottawa
GNG 1103-B00: Engineering Design

Project Deliverable H:

Prototype III and Customer Feedback

<u>Group members:</u>

Alan Wang - 300140660

Rebecca Kimbell - 300233280

Christopher Al-Rahi - 300304285

Abby Falkenham - 300324956

Mohamed Reda Raki - 300281028

Abstract

In this deliverable, feedback received from prototype two and its implications were discussed. The final prototype, prototype three, was created, and the testing and analysis of the prototype were discussed in detail.

1. Introduction

In the previous deliverable, the creation, testing, and analysis of prototype two were discussed. In the following document, the final stage of prototyping, prototype three, will be presented. The purpose of prototype three is to combine aspects of previous prototypes to create a functional system. The deliverable will contain feedback from prototype two and its implications, as well as prototype three.

2. Feedback

After creating our second prototype and showing it to our TA, he gave us a more positive response as of our first prototype. The second prototype was about testing the functionality of the pump and load cell. The load cell ended up giving inaccurate readings so we used the feedback from our TA and got a different load cell altogether that could be programmed more easily. Furthermore, the last piece of feedback given by our TA was to test the specific gravity of more than one liquid which brought us to test the specific gravity of water and Apple Juice.

3. Prototype III

3.1: Load Cell

In the previous deliverable, four load cells were connected in a circuit and a platform was situated on top of them to weigh the samples of fermenting beer. These cells were connected to the Arduino and run through a calibration code. This testing showed a mass value being printed to the console, however, this mass value was not accurate nor consistent throughout the trials. The first step taken to improve the accuracy of the mass measurement was to solder the wires to the amplifier, as they previously were connected solely through contact. However, there was an error made in the soldering process, which could not be reversed by desoldering, and resulted in the amplifier losing its function. As a result, a new load cell and load cell amplifier had to be ordered. Because the previous load cells had to be connected in a circuit to measure the mass, there was a lot of room for error that likely led to the inaccuracy of the mass measurements during the first trials. Because of this, a different type of load cell was ordered: a 20kg load cell weight sensor that was capable of measuring the mass. To create a scale using this load cell, two platforms and spacers were cut out of MDF, and screwed into the load cell. This ensured the load cell was steady, and was capable of taking accurate mass measurements. The wires in this load cell were soldered to the amplifier.

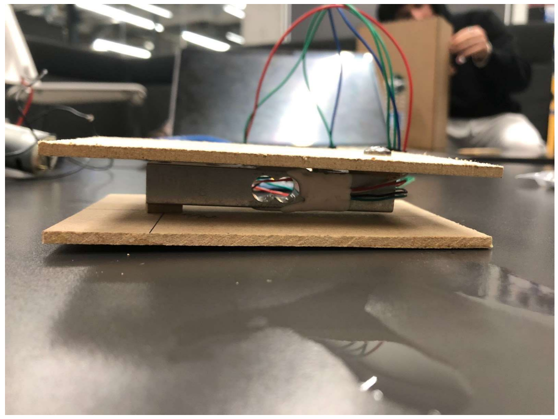

Figure One: Load Cell Scale

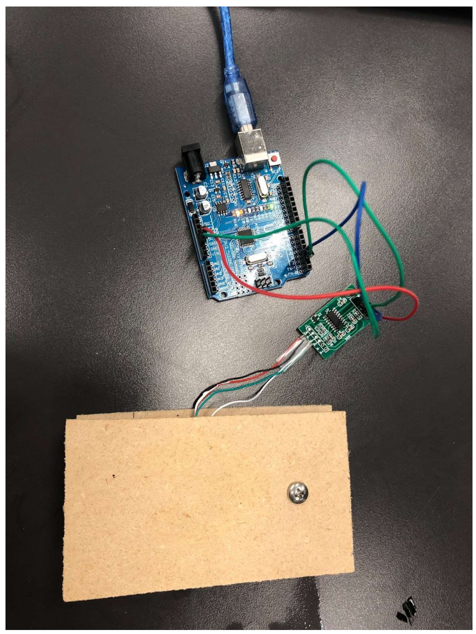

Figure Two: Load Cell and Amplifier Connected to Arduino

3.2: Peristaltic pump

In the previous deliverable, the functionality and reversibility of the peristaltic pump was tested, and it was shown that the pump could work in both directions. This test was done by connecting the pump to an external battery pack, and using the button. In the initial plan for our final prototype, the peristaltic pump could be controlled and reversed automatically through the arduino. However, when attempting to connect the pump to the arduino, it was clear that this was not feasible, as it required parts that we did not have. As a result, the plan for the final prototype changed to control the pump manually. In the final product, the pump would be controlled automatically by the arduino.

3.3: Housing of System

A box was created to act as the structure that houses the system and would be attached to the fermentation tank in the final product. This box was designed using Inkscape. This design was laser cut out of MDF, and glued together. Creating this box allows us to have an outer layer to store all pieces of our product inside. This box will be used to store the Arduino, pump, and reservoir as shown in the figure to the left.

Figure Three: Housing of System

3.4: Pressure Release in Water Bottle

In the previous deliverable, a balloon was fitted on the top of the water bottle reservoir to act as a pressure release system. For this prototype, this system was refined, in order to guarantee a closed system. To do this a hole was made at the top of the water bottle, and a small piece of silicone tubing was put through the hole, and sealed. The balloon was fitted around this tubing, which was secured by sealant. This pressure release system is more airtight, ensuring its effectiveness.

3.5: Prototyping Test Plan

As stated above in the feedback section of this deliverable, our TA told us to test getting the specific gravity of two different liquids of different densities. The goal of this test would be to obtain two separate results to prove that our final prototype can properly get accurate measurements of specific gravity.

3.6: Testing, Analysis, and Results

Test ID	***Test Objective*** ***(Why)***	***Description of Prototype used and of Basic Test Method*** ***(What)***	***Description of Results to be Recorded and how these results will be used (How)***
1	Measure Pump Flow Rate	To Measure the flow rate of the pump, we used a food scale brought from a member's house and used it to measure the change of weight in the water bottle as water is being pumped in it. Water has a density of 1 so every gram difference is 1 mL^3. Tested the amount of weight change with multiple trials in 30-second intervals.	We used these results to calculate the average pump flow rate allowing us to measure the volume within the waterbottle every second. **30 seconds** 1. 33 grams = 1.1 ml/sec 2. 35 grams = 1.17 ml/sec 3. 33 grams = 1.1 ml/sec 4. 32 grams = 1.07 ml/sec 5. 31 grams = 1.03 ml/sec 6. 31 grams = 1.03 ml/sec 7. 31 grams = 1.03 ml/sec 8. 30 grams = 1 ml/sec Final 210 seconds - 226 grams = 1.08 ml/sec Average = 1.07 ml/sec
2	Accurately measure weight	Since the old load cells purchased no longer worked, we got new load cells that we could program and wire more efficiently. We managed to calibrate the load cells using a scale that	After calibrating the scale, the load cell began giving us similar measurements to the food scale. We measured the weight of our water bottle holder with our food scale and got 88 grams, after calibrating our load cell, it also gave 88 grams.

		we know gives accurate measurements, allowing the load cell to calibrate using the libraries given with the known mass.	Accurately measuring weight will allow us to calculate density since we have already managed to account for the volume.
3	Calculate specific gravity	Using the Arduino coding, we managed to have the volume increase by 1.07 mL/sec to signify the rate of the pump flowing into the closed system. We also had the mass outputted to the Arduino from the load cell every 5 seconds and used these two values in the equation d=m/v to calculate the density of the water.	To test the calculations, we had the code run while the pump pumped water in the water bottle and got a close value to 1 for specific gravity which we could use to calculate % Error. We also tested calculating the Specific Gravity of a substance other than water (Apple Juice). Which also proved to be somewhat accurate, giving us a higher value than that of water. Screenshots can be found below the table.

3.6.1: Code For Measuring Specific Gravity

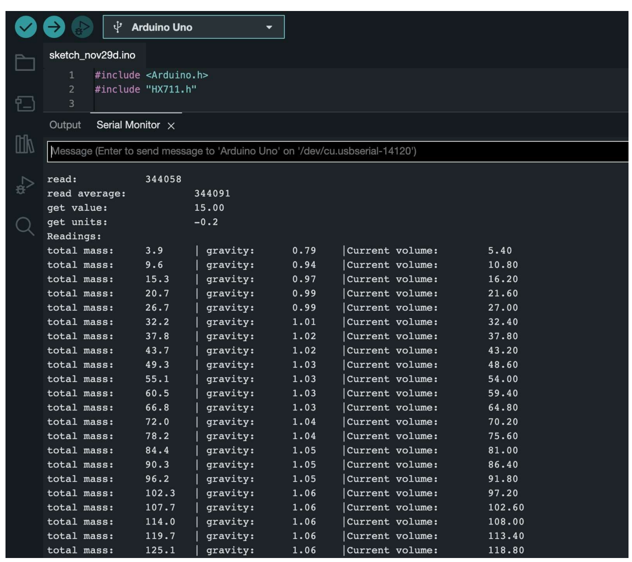

Figure Four: Specific Gravity of Water Output

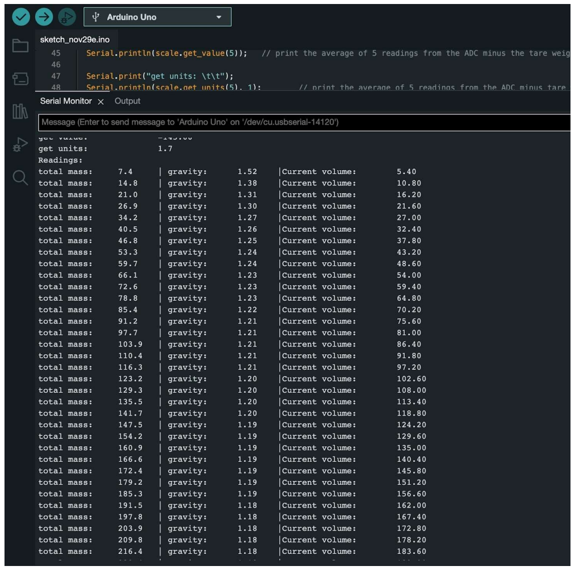

Figure Five: Specific Gravity of Apple Juice Output

4. Conclusion

Our third prototype focused on testing our product as a whole. We used our pump together with the load cells to find a mass value. We tested our product with water and with apple juice to see if we could find an appropriate specific gravity value for both. With water, we knew that the specific gravity should be 1, so we found the mass value of the water with our load cells, and since we had a constant volume, we could find the appropriate gravity value of 1. Then when testing with apple juice, we expected that the specific gravity value would be slightly higher than 1, which is what we found when testing our prototype.

5.Wrike

The wrike plan will showing as screenshots as the previous time due to technical problem

Task	Date	Status
Setting up the hard ware and complete the coding		Completed
Model (complete design finished)		Completed
outline a prototyping test plan		Completed
Design the testing plan		Completed
Testin with water and apple juice		Completed
Testing HX711 working fine		Completed
Testing new box for hard ware		Completed
Testing the pump speed		Completed
Update Wrike		Completed
update your target specifications		Completed
Deliverable H	Nov 20	Completed
Develop a prototype		Completed
Making box for hardware		Completed
Making the side tank		Completed
Making the system that transfer water		Completed
Setting up the hard ware and complete the coding		Completed
Model (complete design finished)		Completed
outline a prototyping test plan		Completed
Design the testing plan		Completed
Testin with water and apple juice		Completed
Testing HX711 working fine		Completed
Testing new box for hard ware		Completed

Task	Date	Status
Deliverable I	Nov 30	In Progress
Asking questions		New
Explain the differentiation in your design		In Progress
Making the slide		In Progress
research and rehearsal		In Progress
Solving Problem(current solutions and alternatives		In Progress
Updating Wrike		In Progress

Task	Assignee	Due	Status
Deliverable J		Nov 15	Completed
A summary of your project	AW		In Progress
Decisions made	MR		In Progress
Manage the Slide	RK		In Progress
Solution options and chosen concept (why/how)	CA		In Progress
Trials and tribulations, lessons learned, future work			In Progress
Deliverable K		Dec 7	New
Adding new things	RK		New
Checking old deliverables and renew data	A R		New
Creating the complete document	C		New