University of Ottawa
GNG 1103: Engineering Design

Project Deliverable H: Prototype III and Customer Feedback

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Abstract

In the following deliverable, our team worked on improving our current prototype design. We were able to improve functionality of the prototype by getting all the sensors running. Additionally, we laser cut and assembled the node mcu housing and the port itself from readily available materials. Prototype was tested to ensure a proper seal, tilt and collection of measurements. Data processing setup was created and tested. All readings are now readily available via Excel for further processing.

Wrike Snapshot (Our Wrike is not functioning).

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1. Introduction

Brewing beer is a unique process that has a lot of elements to it. During the fermentation process, the wort goes through different stages that can be monitored using specific gravity of the liquid. As concentration of various materials changes, so does the specific gravity hence it allows for the user to easily identify what stage the wort is at. Our client is looking to improve and simplify the measurement of specific gravity at his brewery. Our team has put together a device that would do just that. In the following deliverable, we describe our third prototype, what changes have been implemented and why. Additionally, we talk about how the device has been tested, what it means and what we expect from it going forward.

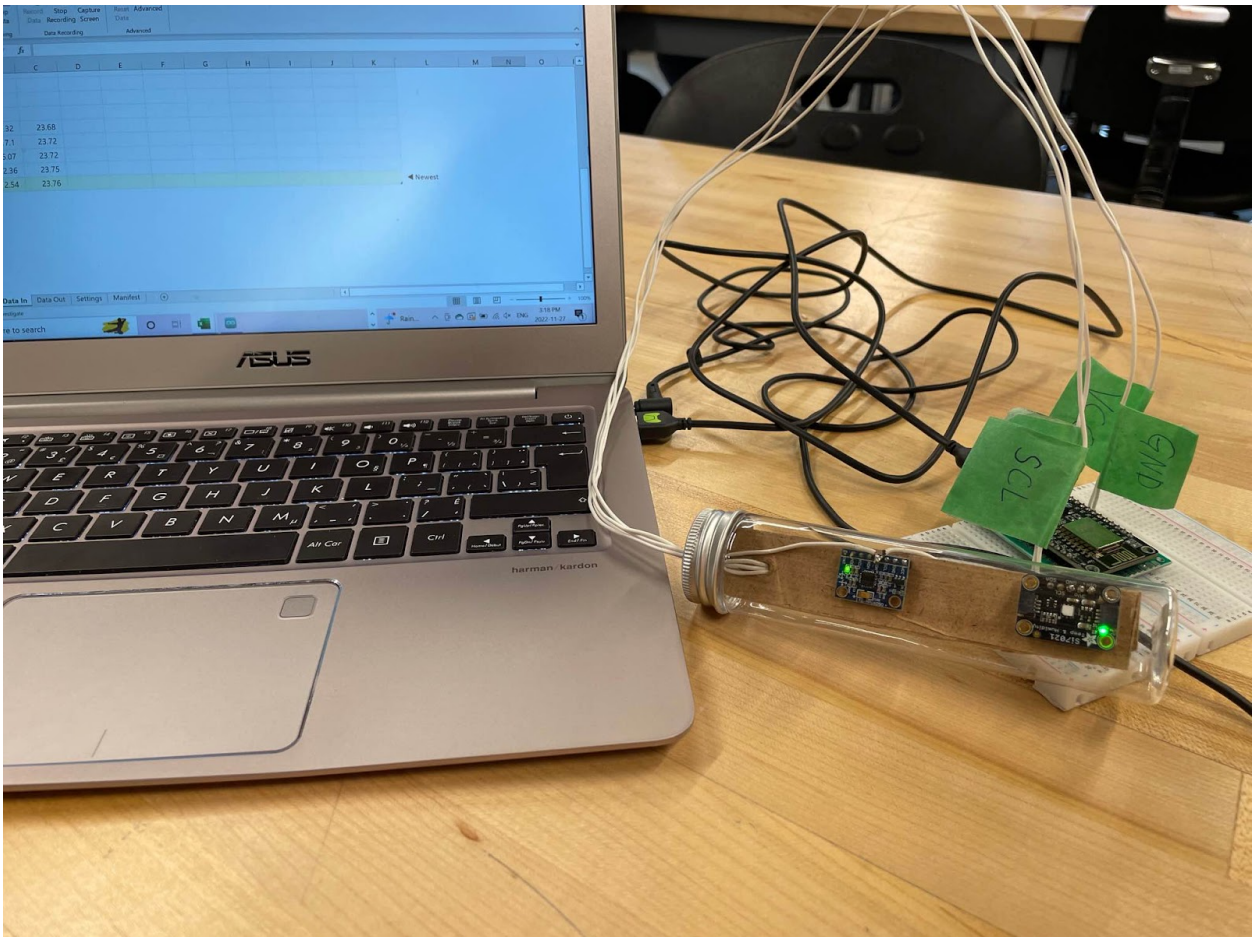
2. Client's Feedback

Our final presentation is where we presented our chosen design idea, all prototypes as well as all the steps, challenges and ideas we have had throughout our time completing this project. This was a great chance to receive feedback on our design from our professor and our peers and also allowed them to voice any concerns they had about the functionality and realistic nature of the final prototype that we will be presenting on Design Day. One of the concerns we received after our final presentation was if our pill (tilt housing for our sensors that is kept in the tank) can withstand the pressure felt inside the tank. This allowed us to share some of the knowledge we gained from previous client meetings and product benchmarking. We found that the maximum amount of pressure that will be found within the tank during the brewing cycle is 0.2 psi. Our plastic pill can easily withstand that amount of pressure for a long period of time without it deteriorating and becoming a health hazard within the tank. Since our device is easily removable it will be taken out for each cleaning cycle since it has an elevated pressure and harsher chemicals present then the brewing cycle. Overall this presentation provided feedback and an opportunity to explain our reasoning and research. This helped reinforce our ideas and ensured we are heading in the right direction. The feedback and questions from the class didn't indicate any need for specific changes or any unanswered concerns over our future prototype.

3. Prototype III

The following prototype showcases the improvements that we accomplished since prototype II. In the image below, improved assembly is presented. We were able to set up node mcu housing and all the sensors. All the components of the pill and the node mcu were soldered. We are able to receive all the readings via Excel with readings being recorded every 10 seconds.

Image 3.1: Prototype III



4. System Analysis

For our project, we are using a tilt gyroscope, which will send the angles in X, Y, and Z dimensions from the gyroscope to the Arduino which we will then, by using code, send it to an excel file. From the excel file, we will plug in our formula, which I will explain further down, and then with the change of the angle, they will be able to see a change in their specific gravity of the beer in the tank, and we can display it on a excel live updating graph to showcase it nicely. The formula we are using is a fluid statics formula derived from chemical engineering concepts, it uses the formula for pressure on curved areas, which is what the angle is determining, we will be using the X, and Y values from the gyroscope to calculate the resultant angle.

For the physical analysis of the system, we will have a plastic pill with the gyroscope and temperature sensor inside it, which will be attached to a wire and placed inside the tank, so thus it is not free floating. We are also using food safe silicone, and other food safe materials for our entire system to meet Shane's expectations. The wire goes through the port on the side of the tank, leading to a Node mcu Wi-Fi module which will receive the data and we can send it to the laptop to process it and display it.

5. Project Updates

Our bill of materials that is presented below has been updated for this prototype. We purchased a bucket to simulate the tank environment. This allows us to test our device further. Additionally, this bucket will be used to demonstrate our device in action during Design Day. We also purchased some screws to secure the port to the bucket to demonstrate how it would attach to the tank. In a real brewery scenario, the port would be attached with a clamp instead.

Table 5.1: Updated Bill of Materials

Material	**Quantity**	**Total Cost (CAD)**	**Source**
MDF	2x2 feet	-	MakerLab Store
Wood Glue	2 mL	-	MakerLab Store
Accelerator/Gyroscope	1	11.00	Amazon Link
Node mcu Wi-Fi Module	1	6.33	MakerLab Store
USB Cable	1	7.00	MakerLab Store
USB-AC Adapter	1	7.00	MakerLab Store
Temperature Sensor	1	13.44	MakerLab Store
Silicone	1	16.35	Amazon Link
Wire	5 feet	5.00	MakerLab Store
Pill Cell	1	1.63	Amazon Link
Node mcu board	1	0.50	MakerLab
Screws	2	0.50	MakerLab
Bucket	1	4.49	HomeDepot
	Total	**$73.24 (taxes included)**	

6. Prototype Testing

For prototype III we performed a few different tests. Our primary goal has been to improve the assembly and functionality of our device this time around. We were able to set up all sensors and receive readings. Both angle measurements as well as temperature

measurements have been displayed correctly via Serial Monitor. We worked on establishing a data transfer to an Excel sheet, which we were able to establish. Both sensors display and record data every 10 seconds.

As for the device assembly, prior to permanently sealing the sensors within the pill, we tested it to make sure no water can get inside. The place of wire entry was sealed using food grade silicon. The pill was subsequently submerged into water for 15 seconds. No water was found within the pill upon inspection. Since the seal was good, we then went ahead and inserted and connected all the sensors. The next step within our assembly was creating a node mcu housing box as well as the port that would be inserted and secured within the available tank opening. The box was laser cut and secured using wood glue. We inspected and ensured aesthetic outcome and secure assembly.

Since we ran out of time this week to do some final testing, we anticipate doing a few more tests prior to Design Day to establish the level of error that we receive when using our device. We plan to meet on Tuesday, November 29th to do a final test within a simulated tank environment, the bucket that we set up for this test, to see how the pill would perform. The test would take approximately 15 minutes. Using the findings, we hope to provide a value for the measurement error.

7. Conclusion

In conclusion, making beer is a unique process with many steps and components to it. Specific gravity is an important measurement that helps to identify at which stage the process is. It is a very useful tool in being able to not just monitor the process, but also perfectly replicate multiple batches of beer. Our client is looking to improve a specific gravity measurement process at his brewery. Our team is proposing a device that would do just that - simplify measurements, but at the same time be easy to use and remove when needed. In this deliverable, we presented our third prototype which included improved assembly and functionality. We established a connection with excel that allows us to process and record data. Our team performed testing for this device to ensure aesthetic setup, secure assembly, and accurate sensor performance. We intend to continue improving our prototype to provide a final functional and aesthetically pleasing set up for our client.