University of Ottawa
GNG 1103: Engineering Design

Project Deliverable E: Project Schedule and Cost

Group Members:

Name:	*Student ID Number:*
Sofiya Fonareva	300334815
Emma Denis	300291562
Erik Ang	300316725
Hasnain Sahibzada	300220482
Aaron Campos Maldonado	300319896

October 23, 2022

Abstract

In the following deliverable, our team continues to work on the device that would allow us to measure specific gravity of fermented liquid in a sealed tank. Below, the project schedule and costs are discussed. The list of required materials and instruments is outlined. Additionally, project risks are analyzed and possible solutions are presented. Prototype test plan and schedules included as well.

Wrike Snapshot:
https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=NHK21zXTJGsnpO01tk9Gn8dMZZ4J2r7b%7CIE2DSNZVHA2DELSTGIYA

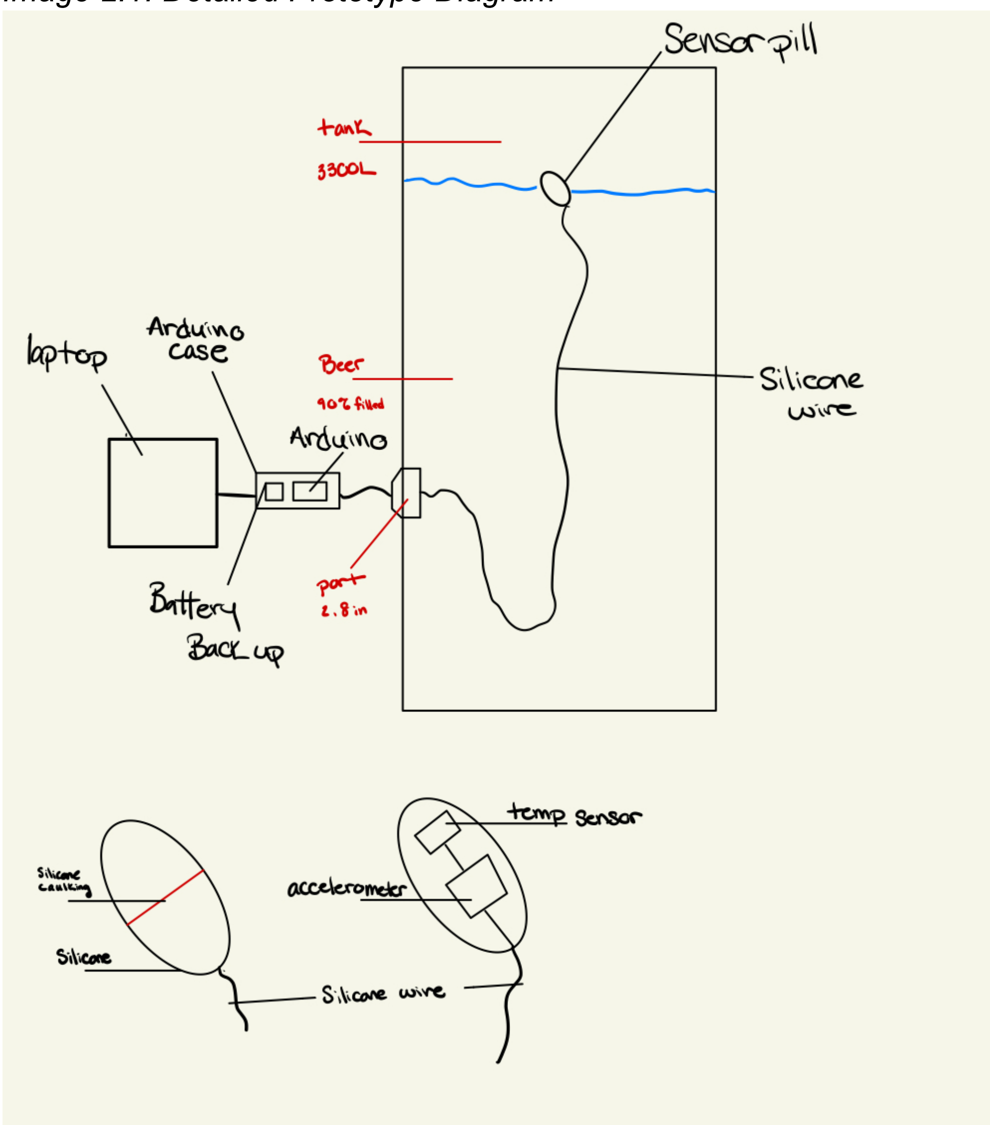
Index

1. Introduction

Regardless of the size of the brewery, similar measurements of the fermented liquid need to be performed to analyze stages of fermentation. Specific gravity is the measurement that is used the most frequently. Our project hopes to allow for a device that can provide our client with accurate measurements continuously and on demand without the need to re-open a sealed tank. In the following deliverable, we discuss materials and instruments that we would require to complete a prototype for such a device. We also outline the cost of producing a prototype like that. Just like any project, there are certain risks that need to be assessed and we do so here as well. Our team intends to verify the quality of our device and its function by testing it. Test schedule is planned below.

2. Prototype Diagram

Image 2.1: Detailed Prototype Diagram



3. Project Materials

Table 3.1: Materials List and their Use

Materials	Use
Accelerator	Calculate Angle
Gyroscope	Calculate Angle
Arduino	System automation
Temperature Sensor	Detect inside temperature
Silicone	Wrap device so it stays waterproof
Laptop	Storage and display of data
Screws	To close enclosure of Arduino and psu
Electrical Wires	Connecting the Arduino to the device
Glue	Hold materials together
Screwdriver	Screw in bolts
MDF	Make case for Arduino/device
Acrylic Tubing	To make sure pill is food safe
PSU (battery) / wiring	Battery is an extra failsafe in case brewery loses power
Wi-Fi Module	To make Arduino have Wi-Fi capabilities

4. Project Budget

Table 4.1: Materials Cost and Store Links

Material	Practicality	Quantity	Total Cost (CAD)	Link to pricing
MDF	Used in device	2x2 feet sheet	Free (scraps)	
Accelerator	Used in device	1	6.99	https://www.amazon.ca/Robojax-MPU-6050-Gyroscope-Accelerometer-Raspberry/dp/B07DLQL96

Gyroscope	Used in device	1	11.00	https://www.amazon.ca/Neuftech-MPU-6050-3-Gyroscope-Accelerometer-Crafting
Arduino	Used in device	1	10 (makerspace price)	https://edu-makerlab.odoo.com/shop/product/arduino-5#attr=6
Temperature Sensor	Used in device	1	10 (makerspace pricing)	https://edu-makerlab.odoo.com/shop/product/humidity-temperature-sensor-23?page=2#attr=235
Silicone	Used in device	1	17.98	https://www.amazon.ca/Clear-Food-Grade-Silicone-Sealant/dp/B0063U2RWU/ref=sr
Laptop	Not used in device	1	0 (prior device needed)	
Screws	Used in device	8	0.80	**https://edu-makerlab.odoo.com/shop/product/flat-head-wood-screws-75#attr=380,389**
Electrical Wires	Used in device	3	7.50	https://edu-makerlab.odoo.com/shop/product/wire-5ft-45?search=wire#attr=213,21
Battery	Used in device	1	1.00	https://edu-makerlab.odoo.com/shop/product/battery-90?search=battery#attr=161
Wifi Module	Used in device	1	6.33	https://edu-makerlab.odoo.com/shop/product/node-mcu-wifi-module-43?page=2#attr=67
		Total	**$61.66 (taxes included)**	

5. List of Equipment

- *3D Printer*

We will use a 3D printer to print housings for the different components we use such as the inside of the submersible tube that goes inside the tank. Also, we can use the printer to print more intricate parts that a laser cutter might not be able to do. Furthermore, we can use 3D printing to make moles for materials such as silicon which we will probably use to make the device food safe.

- *Laser Cutter*

We will use a laser cutter to primarily make the housing of external components such as the housing for the Arduino outside of the tank. It will also be used more than the 3D printer due to the faster speed that a laser cutter provides.

- *Soldering Iron*

Soldering will definitely be used to complete the finished product by connecting our components together by soldering wires to them to give a more finished product. We will also use one if we end up designing and producing a printed circuit board (PCB) so we can solder our components directly to the PCB without the use of messy wires.

- *Drill Press*

We assume that we will need to use a drill press or some sort of metal machining device because we know that we will have to make a metal cap to go on the tank's tri clamp port.

- *Glue*

We will need to use glue to possibly glue together possible 3D printed and laser cut pieces and also other components that we will need to secure.

- *Screwdriver*

Screwdrivers may be used to obviously tighten down screws that we may use over glue to put together the housing for our device.

6. Project Risks

Each project has potential risks. In the following section, our team discusses what our project risks are and how we plan to mitigate them.

The first project risk for our team is device buoyancy. For the sensors to work properly and record data that we are looking for, the device must float at the top of the fermented liquid and measure the angle at which it is free floating. However, if the device is not fulfilling this requirement, we would not be able to receive accurate readings. In order to mitigate this problem, we performed extensive research to verify what the best sensor casing would be to make sure it would float and added it to the list of our materials. Additionally, we kept the project quite under the budget to have room to explore more options if needed. We created a detailed prototype testing plan and schedule to be able to test and verify the device early on, so if needed faulty equipment can be caught early to give us more time to perfect it.

Secondly, time constraint is another risk. We are limited to just over a month to complete and test our 3 prototypes. Time is a huge limiting factor, which requires us to start quite early to make sure we fit within the set timelines. For that reason, we set up the following prototype testing schedule as well as planned ahead using Wrike.

Thirdly, device performance malfunction or lack of accuracy is our next risk. We are hoping that the prototype will perform readings as required but there is always a chance that it will not. In that case, we are hoping to catch malfunctions early on by using our detailed prototype test and schedule plan. In cases of malfunction, we would consider swapping our sensors for something else to increase performance and accuracy.

Finally, there is a risk that our final prototype or device would not fulfill our clients needs. In order to avoid this issue, we will work hard to incorporate our clients' feedback every step of the way. Additionally, we will be assessing our prototype device against our design criteria each team meeting to verify that we are indeed fulfilling our objectives.

7. Prototype test plan

Table 7.1: Prototype I Test Plan and Schedule

	Test	**Objective**	**Schedule**
Test 1	Device assembly.	Verification that all parts are put together aesthetically but also correctly.	November 5th. Test duration: 5 minutes.
Test 2	Device buoyancy.	Device to be placed in the water with wiring to verify its buoyancy and to make sure wiring does not affect it.	November 5th Test duration: 10 minutes
Test 3	Code testing.	Verification of the code using arduino and PC.	November 5th Test duration: 10 minutes
Test 4	Sensors testing to verify their performance.	Device to be placed in the water to receive measurements.	November 5th. Test duration: 30 minutes.
Test 5	Wi-Fi Module	Verification of Wi-Fi module set up.	November 5th. Test duration: 10 minutes.

Table 7.2: Prototype II Test Plan and Schedule

	Test	**Objective**	**Schedule**
Test 1	Verification of assembly.	If any structural changes were to be made, the device would be verified again to confirm its assembly.	November 10th. Test duration: 5 minutes.

Test 2	Device buoyancy.	Device to be placed in the water with wiring to verify its buoyancy and to make sure wiring does not affect it.	November 10th Test duration: 10 minutes
Test 3	Code testing.	Verification of the code using arduino and PC if any changes were made.	November 10th Test duration: 10 minutes
Test 4	Sensors testing to verify their performance.	Device to be placed in the water to receive measurements.	November 10th. Test duration: 30 minutes.
Test 5	Wi-Fi Module	Verification of proper work of the Wi-Fi module.	November 10th. Test duration: 10 minutes

Table 7.3: Prototype III Test Plan and Schedule

	Test	**Objective**	**Schedule**
Test 1	Device assembly.	Last verification step that all parts are put together aesthetically but also correctly. No leaks through the port entry.	November 20th. Test duration: 5 minutes.
Test 2	Code testing.	Last verification of the code using Arduino and PC that it runs smoothly.	November 20th Test duration: 10 minutes
Test 3	Sensors testing to verify their performance.	Device to be placed in the water to receive measurements.	November 20th. Test duration: 30 minutes.
Test 4	Verification of device fitting set design criteria.	Verify design compared to set parameters and client's feedback.	November 20th. Test duration: 15 minutes.

8. Conclusions

In conclusion, this deliverable outlines project schedule and costs. As a team, we have decided on the list of the materials and equipment that we would require to complete this project. Upon our research, the project budget was created and recorded. Additionally, all project risks were assessed. We discussed what these risks are and set up contingency plans to mitigate them. Prototype schedule and testing was created to keep us on track during our design journey.