GNG1103

Design Project User and Product Manual

Baby Santa Hydrometer

Submitted by:

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December 7th 2022

University of Ottawa

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Insert your list of figures here (right-click to update this field).

List of Tables

List of Acronyms and Glossary

Provide a list of acronyms and associated literal translations used within the document. List the acronyms in alphabetical order using a tabular format as depicted below.

Table 1. Acronyms

Acronym	Definition
BSH	Baby Santa Hydrometer

Table 2. Glossary

Term	Acronym	Definition
Alcohol by Volume	Abv	The percentage of alcohol by volume of drink.
Specific Gravity	SG	Ratio of an unknown density to a known density, usually water

1 Introduction

Beyond the Pale

Explain the basic context for your work and any assumptions that you have made for your work. Give an overview of the structure of your document (i.e. explain how it is organized) and summarize the purpose of the document, the scope of activities and the intended audience for the document. Also describe any security or privacy considerations associated with the use of the User and Product Manual.

This User and Product Manual (UPM) provides the information necessary for <types of users> to effectively use the BSH and for prototype documentation.

2 Overview

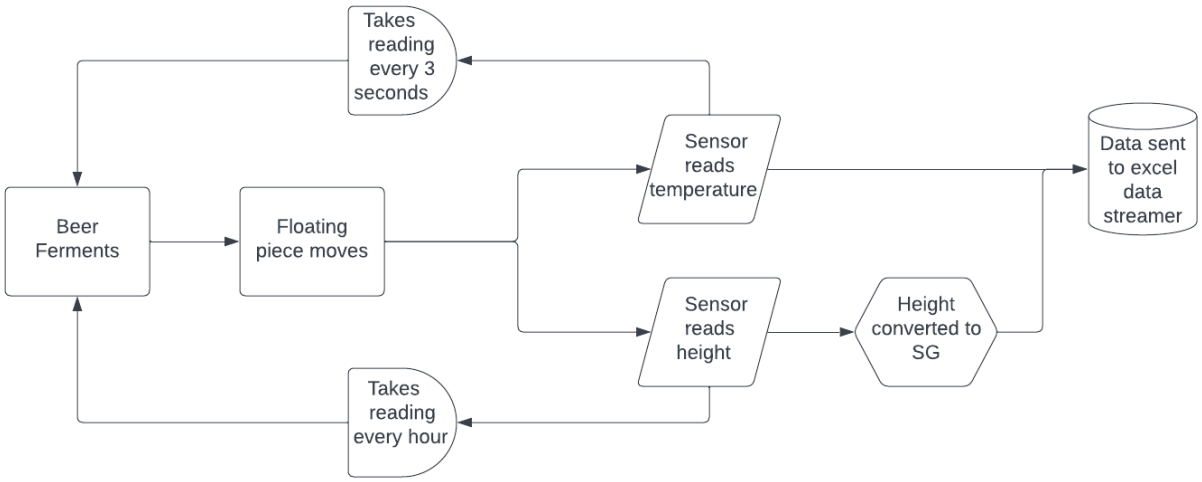
Beyond the Pale is unhappy with their current tools used to measure SG of their fermenting beers. The SG is used to find the abv.

Beyond the Pale Brewery needs a tool that measures specific gravity and temperature, records the data and sends it to a centralized hub. The device must meet safety standards as well as physical limitations of the tank it is used for.

Our prototype uses a very intuitive design based on existing hydrometer standards. It fundamentally, is a floating object with a sensor to track how high or low it is floating. The sensor just removes the human element of having to look at the traditional hydrometer.

[add your final prototype picture]

As the beer ferments, the floating piece will change height and every hour the ultrasonic sensor will take a distance reading to find the SG. The temperature sensor generates a reading every 3 seconds. All readings are sent to the excel data streamer device.



2.1 Cautions & Warnings

The Arduino housing must be secured at all times considering it does contain the electrical components of the device. Therefore, a waring/caution our device has relates to the Arduino housing as it could be dangerous if not secured properly.

3 Getting started

Since our device isn't too large, it will be coming in one piece with everything already assembled. Therefore, our manual is quite simple to follow (excel has its own part).

First, take the device and put it through the port at the bottom of tank.

Secondly, use the compression fitting that came within the assembly package and compress the device hook from part one with the fitting.

Next, make sure the counter weight that is at the top of the device seems balanced.

Finally, plug the device cable into an outlet.

3.1 Configuration Considerations

Briefly describe and graphically depict as appropriate the equipment, communications, and configuration of the system in a way that a non-technical user can understand. Include the type of input and output devices or tools needed.

3.2 User Access Considerations

- Lab tech (main job to count yeast, but is sometimes need to measure the specific gravity)
- Head and assistant brewer
- Other brewers (not BTP)

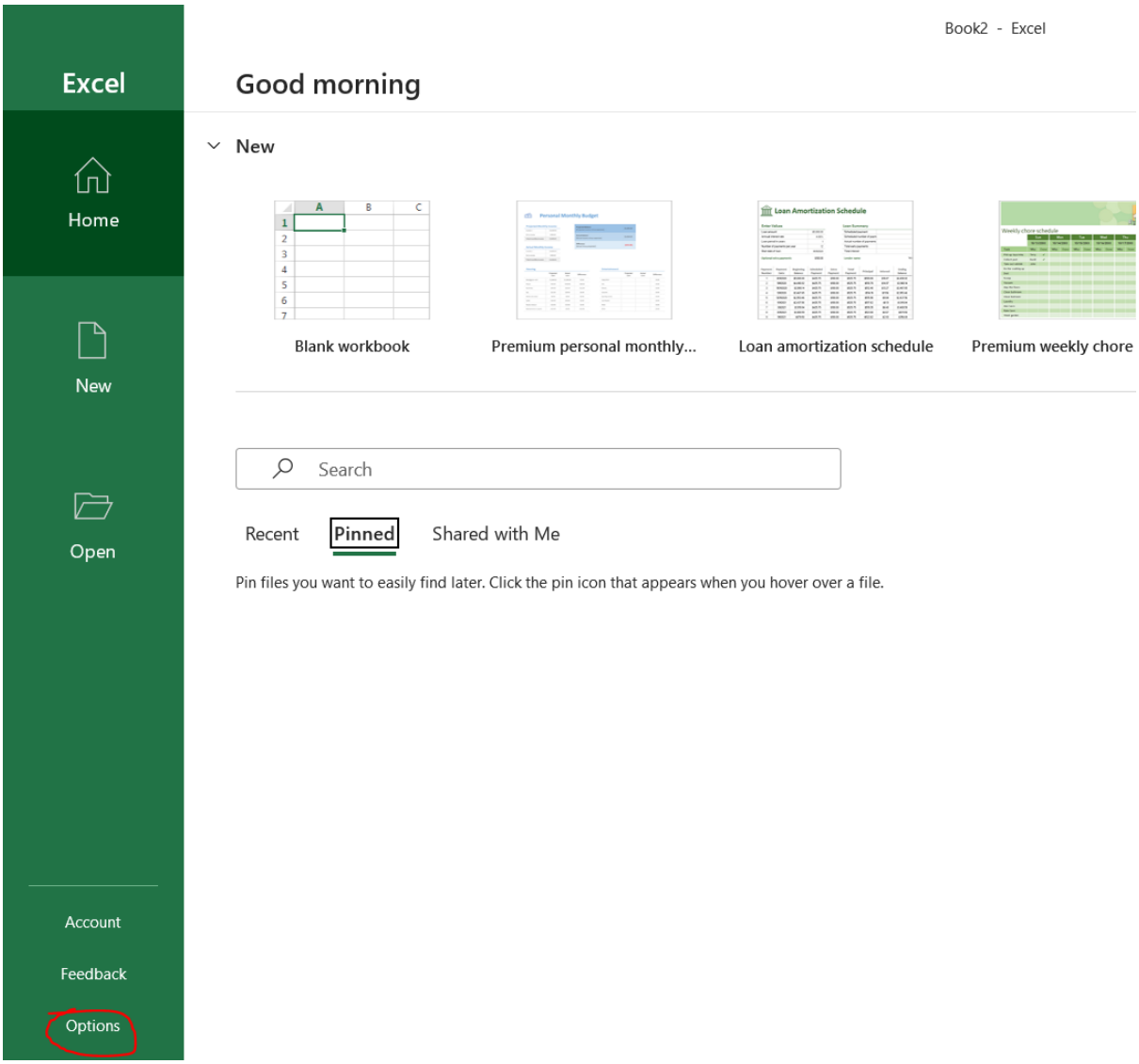
There are no obvious restrictions for the user; however, personal illness is not included in our abbreviations.

3.3 Accessing/setting-up the System

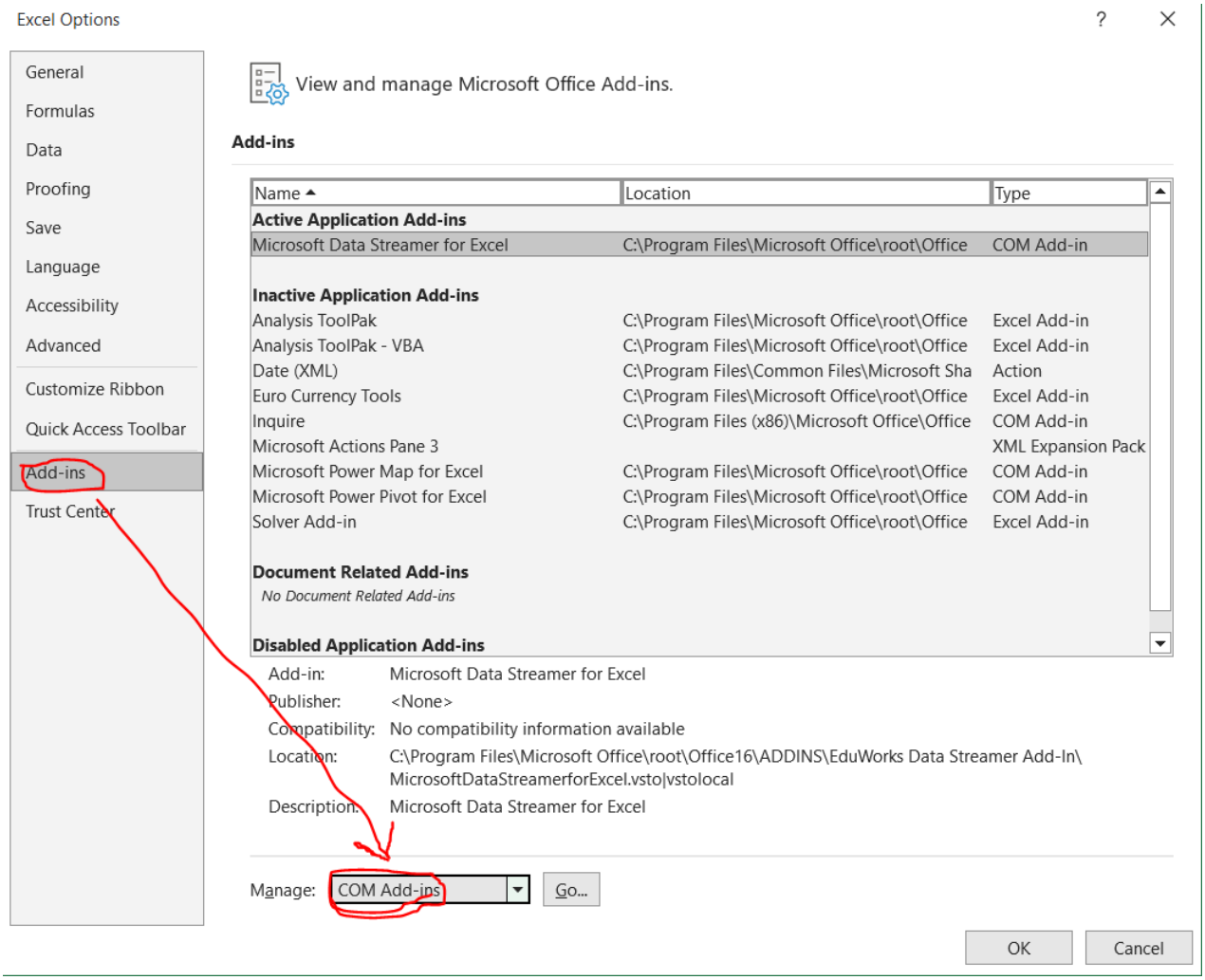
The Data Streamer plug-in is a built in plug-in that needs to be enabled.

To enable:

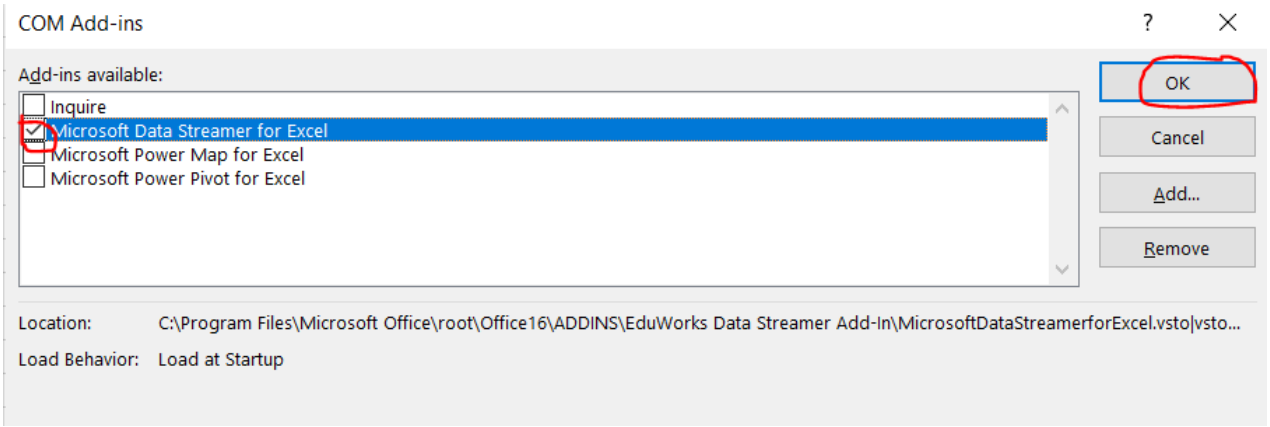
1. File>options



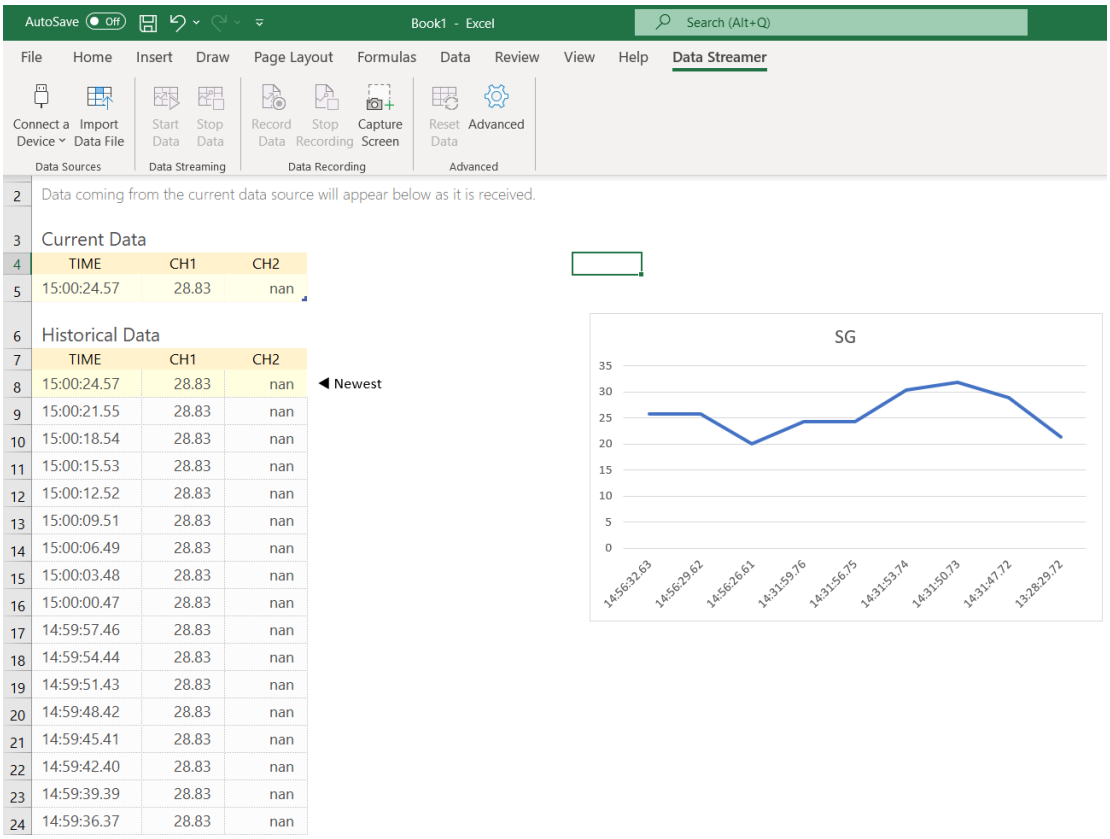
2. Add-ins>Manage: COM Add-in>Go



3. Check Data Streamer and click Ok

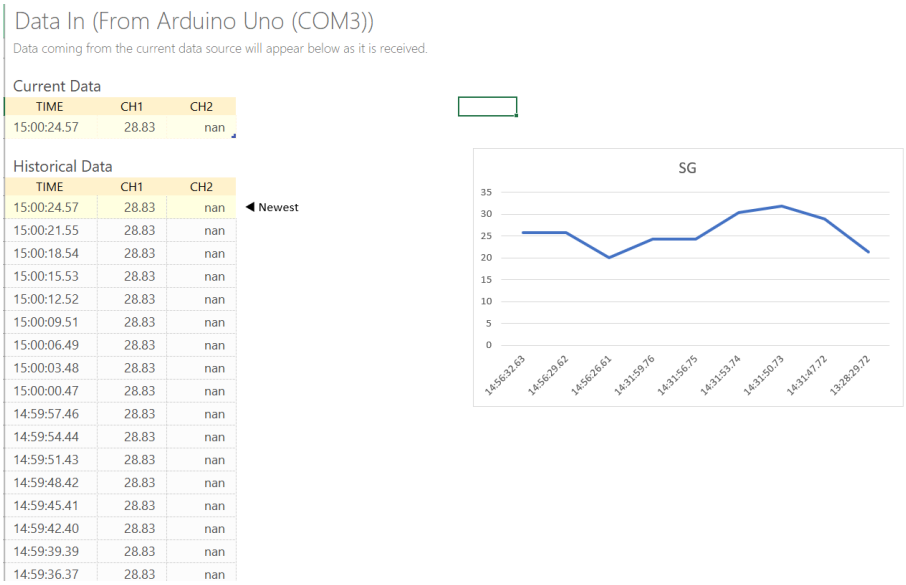


4. To collect data simply go to the “Data Streamer” tab, connect your BSH, and click “Start Data.” “Stop Data” will stop the data from flowing in, and “Record Data” will allow the user to save this data to a .csv file.



3.4 System Organization & Navigation

The main component of our system is just a basic excel sheet that shows and represents the data being collected in a table and graph format. Unfortunately, there is nothing too complex for how it will be displayed or collected; however, the basic functionality works properly.



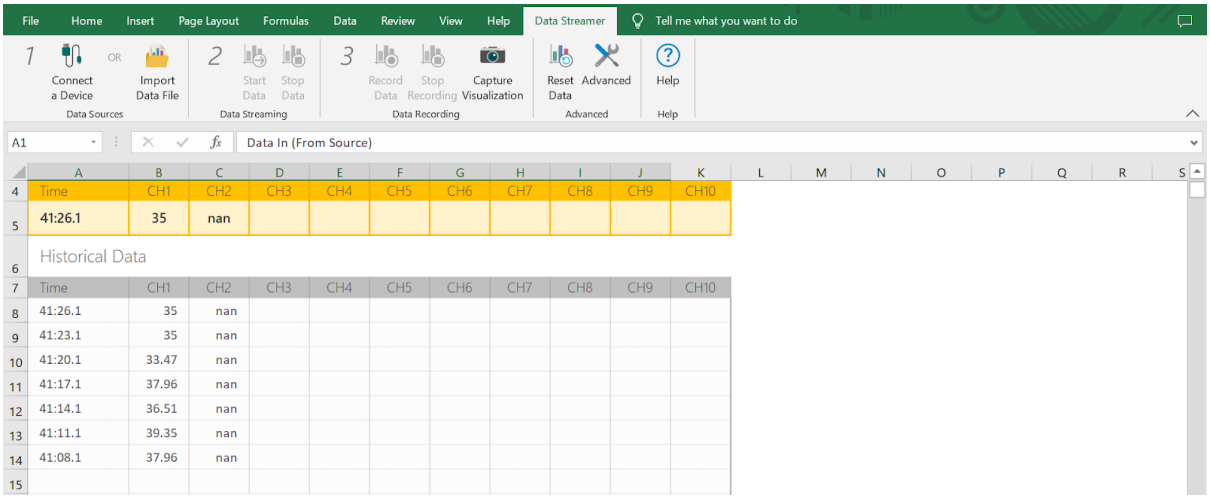
3.5 Exiting the System

- Unplug the cable from the outlet to turn off
- To turn back on and run the device all you would have to do is plug the cable back into the outlet

4 Using the System

Provide a detailed description of each user function and/or feature, explaining in detail the characteristics of the required input (push a lever, button press, etc.) and system-produced output. Each function/feature should be described under a separate sub-section header, 4.1-4.x, and should correspond sequentially to the system functions (e.g., menu items) and/or features listed in certain sub-sections found in this document. Include pictures or screenshots as needed to depict examples. This section of the manual may also be tailored or customized based on defined user roles, if appropriate. The information is this section is specific to the user interactions with the system and is different than the prototype documentation section below.

- Our product operates using two sensors: Ultrasonic and Temperature sensor
- Both these data will be uploaded via Microsoft Excel using the data streamer plug in.



Time	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8	CH9	CH10
41:26.1	35	nan								

Time	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8	CH9	CH10
41:26.1	35	nan								
41:23.1	35	nan								
41:20.1	33.47	nan								
41:17.1	37.96	nan								
41:14.1	36.51	nan								
41:11.1	39.35	nan								
41:08.1	37.96	nan								

With Excel, we will connect our Arduino there. After, the user can Start and record all the data. After recording The user can then save the data with the help of Microsoft excel.

4.1 Ultrasonic Sensor

- The Ultrasonic sensor is used to measure the distance of our floating device (which is inside our hydrometer) and uses that distance to calculate the specific gravity of the beer.
- From the code, the ultrasonic sensor will detect using soundwaves how far/close our floating device is. Using that it will transmit that to the Arduino which will then be used to calculate the specific gravity of the beer.

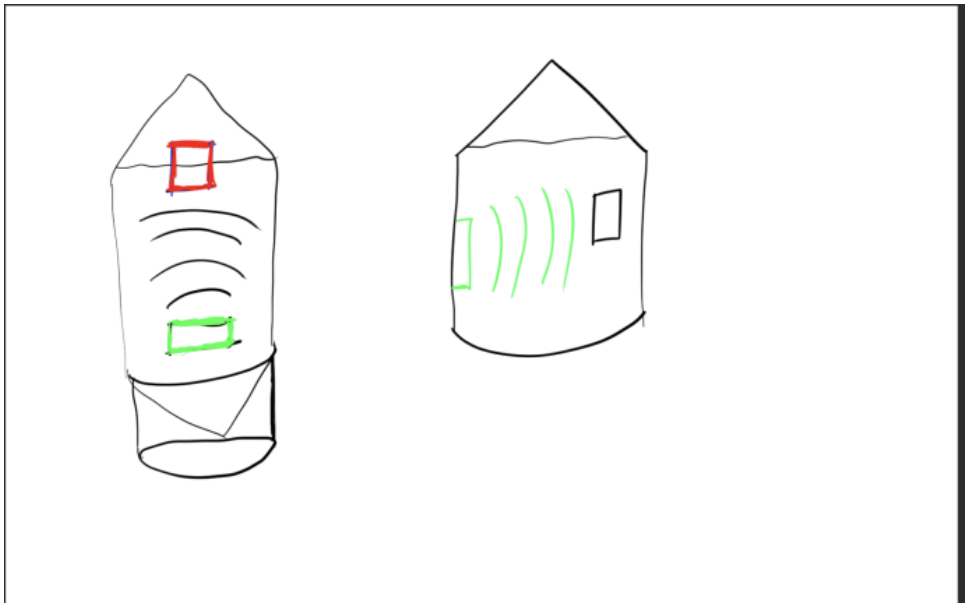


Image 1. Feng, R. (2022) *Idea 1*.

- A simple diagram of how the Ultrasonic sensor (box in green) will look up to the floating device to find out the distance and then calculate the specific gravity.

- Our ultrasonic sensor along with the Temperature sensor will be located inside the main body of our Hydrometer (below the floating device)

4.2 Temperature Sensor

- The temperature sensor will be used to find the temperature of our beer. Similar to the ultrasonic sensor, it will be connected to the Arduino board. With the help of the code, the temperature sensor will be able to find the temperature of the beer, send it to the Arduino, which will then be used to send it to excel (where all the data will be displayed).

4.2.1 <Given Sub-Function/Sub-Feature>

Include additional sub-sections as necessary for system sub-functions or sub-features, if they exist.

5 Troubleshooting & Support

Describe all recovery and error correction procedures, including error conditions that may be generated and corrective actions that may need to be taken. Organize the information in sub-sections as appropriate. The following are common sub-sections that may be included as appropriate. Remember that someone who is not an engineer must be able to follow these steps.

5.1 Error Messages or Behaviors

Identify the error messages or behaviors that a user may receive or parts that are prone to breaking and the likely cause(s) and/or possible corrective actions for the error. If the list is extensive, this information may be best provided in an appendix to the document that is referenced here.

5.2 Special Considerations

If applicable, describe any special circumstances, actions, caveats, exceptions, etc., that should be considered for troubleshooting.

5.3 Maintenance

The physical model (not including the Arduino housing and its contents) must be regularly and thoroughly cleaned to reduce the buildup of residue from the wort. The buildup of residue may lead to a drop in efficiency and/or flawed results.

5.4 Support

The contact for support are:

- Ricardo Feng P., (343) 558-2759

Provide information on how the user can get emergency assistance and system support (e.g., help desk support, production support, etc.). Include the names of the responsible person and email addresses of the staff who serve as points of contact for system support. Also provide instructions for how identified problems with the system are to be reported. Include instructions for security incident handling, as appropriate.

6 Product Documentation

The prototype was made using 3D printers. The group used On-shape to do the models and parts of the product. These parts of the product can be 3D printed within 7 to 1 hour, depending on the part due to the limited time of 8 hours that you have to 3D print at the University. The prototype was principally made of plastic and propylene using 3D printers, but the product should be made of stainless steel or any other materials that does not contaminate the liquid are also a good option.

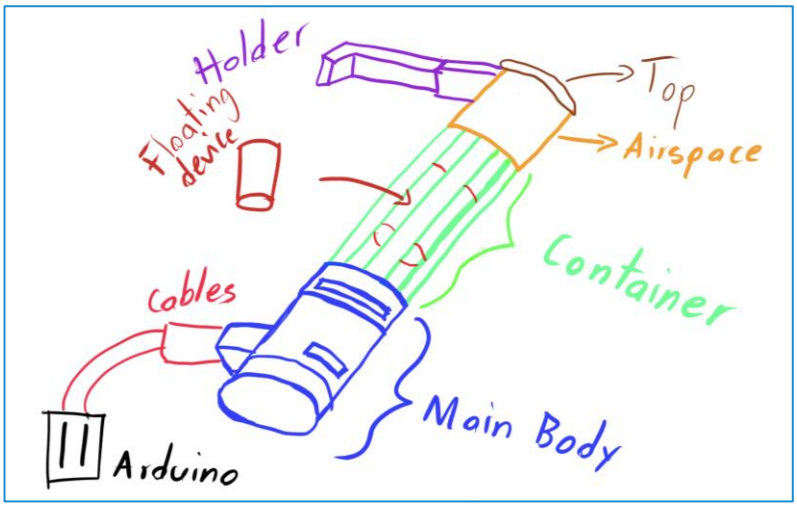


Image 2. Feng, R. (2022) *SGC Product Ill.*

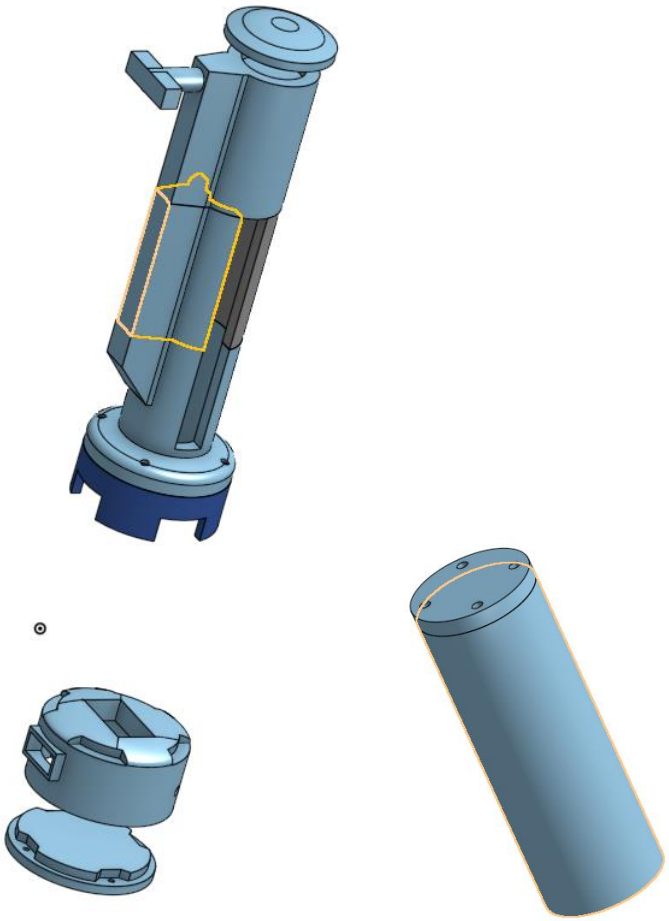


Image 2. Feng, R. (2022) *SGC Product.*

After 3D printing the floating device, it needs to have a mass that makes the object equal to the density of water using the formula d=v/g. In our case, the floating device needs to have a mass of 121.647g to have the same density as water. The screws and superglue were used to assemble the prototype. The small circular hole in the main body of the prototype is for the term sensor and the square hole on top of the main body is for the ultrasonic sensor. The third whole is for the cables that connect the sensors and the Arduino that are going to be outside of this part and store in the Arduino housing 3D model.

For example, if stainless steel was an arbitrary choice for a particular part, you could indicate that other materials (e.g. plastic or wood) might also be an option but were not tested. However, if metal that resists corrosion is the basic requirement and you tested several materials before choosing

stainless steel (i.e., the choice is not arbitrary) then you can indicate this here, along with supporting data. Sometimes, material needs to be swapped, if no longer obtainable or if no longer cost-effective, present any work that you did that might help another designer make material substitutions or even note the basic requirements (e.g., must resist corrosion in a humid room environment for 30 years).

The same is true for critical portions of software or expensive/sensitive electronic functionality. Basically, if you were worried about a portion of the design and "settled" on a particular solution or method, then it needs to be documented. This includes the testing or analysis that you did to arrive at that specific solution.

Support this explanation with relevant design files you have made (circuit or mechanical diagrams, code, flowchart, 3D models, laser cutting files, etc.). Add pictures to help your explanation. This section should be presented like an instructables manual with many pictures and clear steps to create the prototype.

Formula for the density of water

DO=density of the object

AV= Volume that is not submerged of the object

DL=Density of the liquid

SV=Volume submerged

DO*AV=DL*SV

DL=(DO*AC)/SV

ERservices(n.d.)

6.1 <Subsystem 1 of prototype>

6.1.1 BOM (Bill of Materials)

	Source	Cost ($)
Arduino UNO R3	Makerstore	9.00

Bluetooth Module (Bluefruit LE)	Makerstore	12.99
Ultrasonic sensor	Makerstore	4.00
Jumper Cables (pack of 40)	Makerstore	4.00
Breadboard (4.6x3.6 cm)	Makerstore	1.50
USB Cable (A to C)	Makerstore	7.00
screws (using 4)	https://www.homehardware.ca/en/10-pack-6-x-12-pan-head-self-drilling-tap-screws/p/2166882	2.59
PLA material	Makerlab	10.00
Temperature Sensor	Makerstore	10.66
Total	----------	61.74
Limit	----------	100

6.1.2 Equipment list

Product Name	Description	Type	#	Source
Arduino IDE	Will be used to write and encode the necessary scripts into the Arduino UNO	Analytical Focused	#1	Download (Installed during Lab 2)

	that will be utilizing the URF.			
CAD Software (Onshape)	Will be used to visualize the product in a 3D space and needed to initiate a print.	Analytical Focused	#2	Download (Installed during Lab 3)
3D Printer	This will use the previously Computer assisted design to print the product.	Physical Focused	#3	Makerspace
Various Onshape and Arduino Libraries	---------- ---------- ---------- ---------- ----------	---------- ---------- ---------- ---------- ----------	#4	Thingiverse GitHub

Excel	This will be used to store and graph our data.	Analytical Focused	#5	Download (Installed during Lab 1)

6.1.3 Instructions

Explain step by step instructions on how to build this specific subsystem. Include as many pictures and diagrams for clear understanding of the process. Make sure to attach all files you are referencing.

6.2 Testing & Validation

The tests are incomplete since we couldn`t afford a waterproof sensor to test our product in water or in another liquid. Even though we didn`t test it in water, the ultrasonic can find the distance between it and the floating device without the obstruction of other agents.

The Arduino UNO does its calculations, but it presents them in a negative value, so we change it by multiplying a minus 1. The accuracy of the specific gravity taken by the product is unsure because we do not have a method to validate the results that we were getting.

7 Conclusions and Recommendations for Future Work

During the entirety of the project, we have had to use our many learned skills to develop a working prototype from our initial sketches. Firstly, we had to program a script/code from scratch

I recommend to put the ultrasonic range finder sensor on the top of the product looking downwards in case that the pressure of the water can generate some abnormalities to get the distance when there`s fluid that can interrupt the wave of sounds that the sensor generates and needs to catch.

Summarize your lessons learned and your work related to your prototype and suggest the most productive avenues for future work so that other groups can continue and improve upon your work.

What would you do if you had a few more months to work on this project? What are the things that your abandoned because of lack of time but would be important to add?

8 Bibliography

ERservices (n.d.) *Archimedes' Principle.*

Feng R. (2022) *Idea 1*. Illustration.

Feng, R. (2022) *SGC Product Ill.* Illustration.

Feng, R. (2022) *SGC Product.* Figure. https://cad.onshape.com/documents/8a90d2533028d9594649f9da/w/152c3a468d70160414763d36/e/160c3249af2530ecf30174a4?renderMode=0&uiState=638f73d10b703b3432b7c0c9

Insert your list of references here.

APPENDICES

9 APPENDIX I: Design Files

Summarize the relationship of this document to other relevant documents. Provide identifying information for all documents used to arrive at and/or referenced within this document (e.g., related and/or companion documents, prerequisite documents, relevant technical documentation, etc.).

Include all design files in MakerRepo. Also provide the MakerRepo link to your project.

Table 3. Referenced Documents

Document Name	Document Location and/or URL	Issuance Date
Deliverable E – Project Plan	Link	
Deliverable F – Prototype 1	Link	
(MakerRepo)	Link	

10 APPENDIX II: Other Appendices

You can include other critical and important work here. Maybe they are not important in the structure of this document but need to be included.