Deliverable D

Conceptual Design

GNG 1103
Design

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Introduction

In this report, our team took the design criteria we derived from our client meeting with Shane from Beyond the Pale Brewing Company to rank different possible solutions our team was able to put together. We split up our system into 3 smaller subsystems and came up with multiple solutions for these smaller subsystems. From those solutions, we put them together to form an overall possible solution for the system. As previously stated, we used the design criteria to rank 3 overall solutions and chose the best solution according to our design criteria.

Subsystem Solutions

Jack's Subsystems Solution

Table 1: Temperature Sensor LM 35

Design Specifications	Technical Specs	LM 35 Specifications
Cost	$1,562.00	$2.60
Range of temperature	0 to 75c	-55 to 150c
Accuracy	+/- 0.5c	+/-0.5c

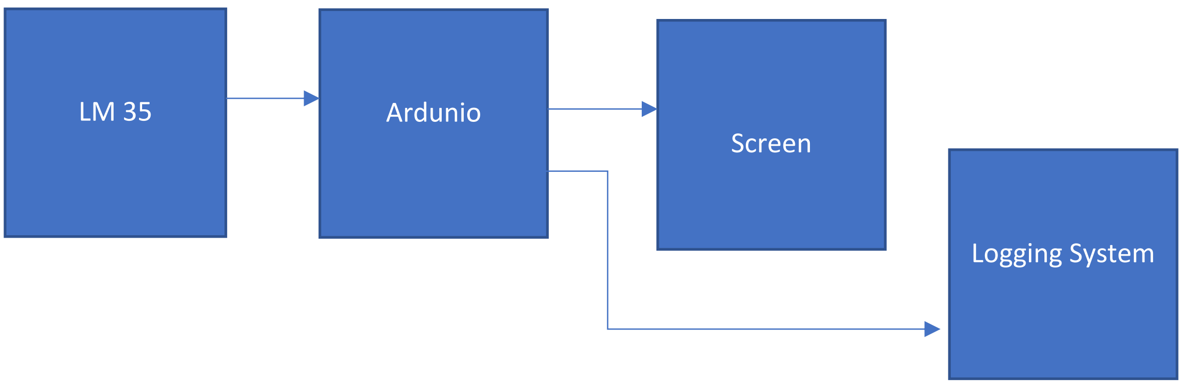


Table 2: Data Transfer WeMos

Design Specifications	Technical Specifications	WeMos
Cost	$1,562.00	$6.66
Memory Transfer	1 GB	4mb

- Allows a connection with Wi-Fi from an Arduino board to a browser on anyone's device that has a connection to the internet
- A SD card with a WeMos D1 mini-SD card shield we can store over 1 GB

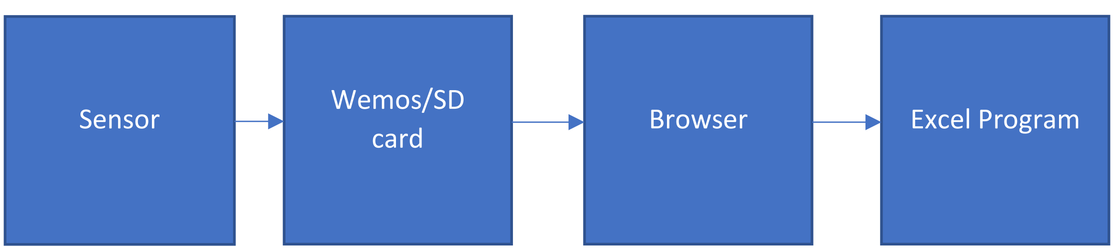
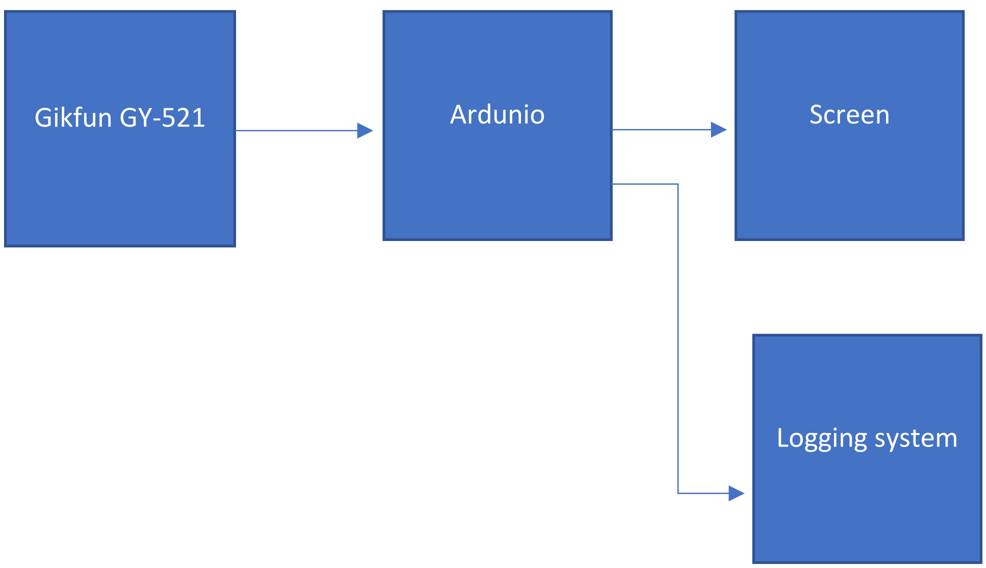


Table 3: Specific Gravity Sensor:

Design Specifications	Technical Specs	Specific Gravity System Specs
Food Safe		Stainless Steel 304
Free Floating	No	No
Sample less	Yes	Yes

- The Gikfun Gy-521 sensor will measure motion. This will allow us to measure how much the device will sink or float in the product gaining those measurements we are able to calculate the specific gravity.
- The sensor will be placed in plastic bottle that will be secured in a stainless-steel tube that will be threaded together.



Nick’s Subsystem Solutions

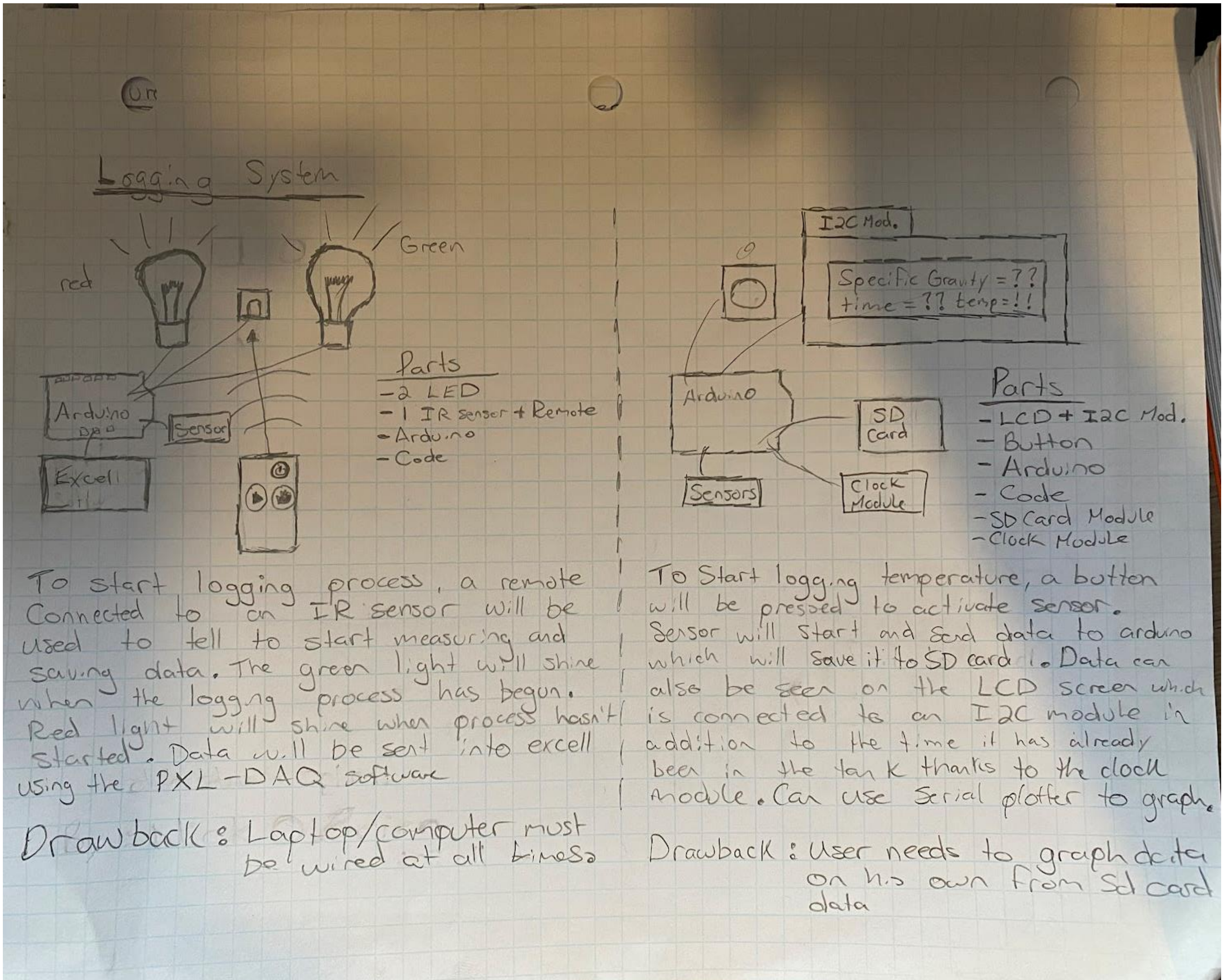


Figure 1: Nick’s Logging Subsystem Ideas

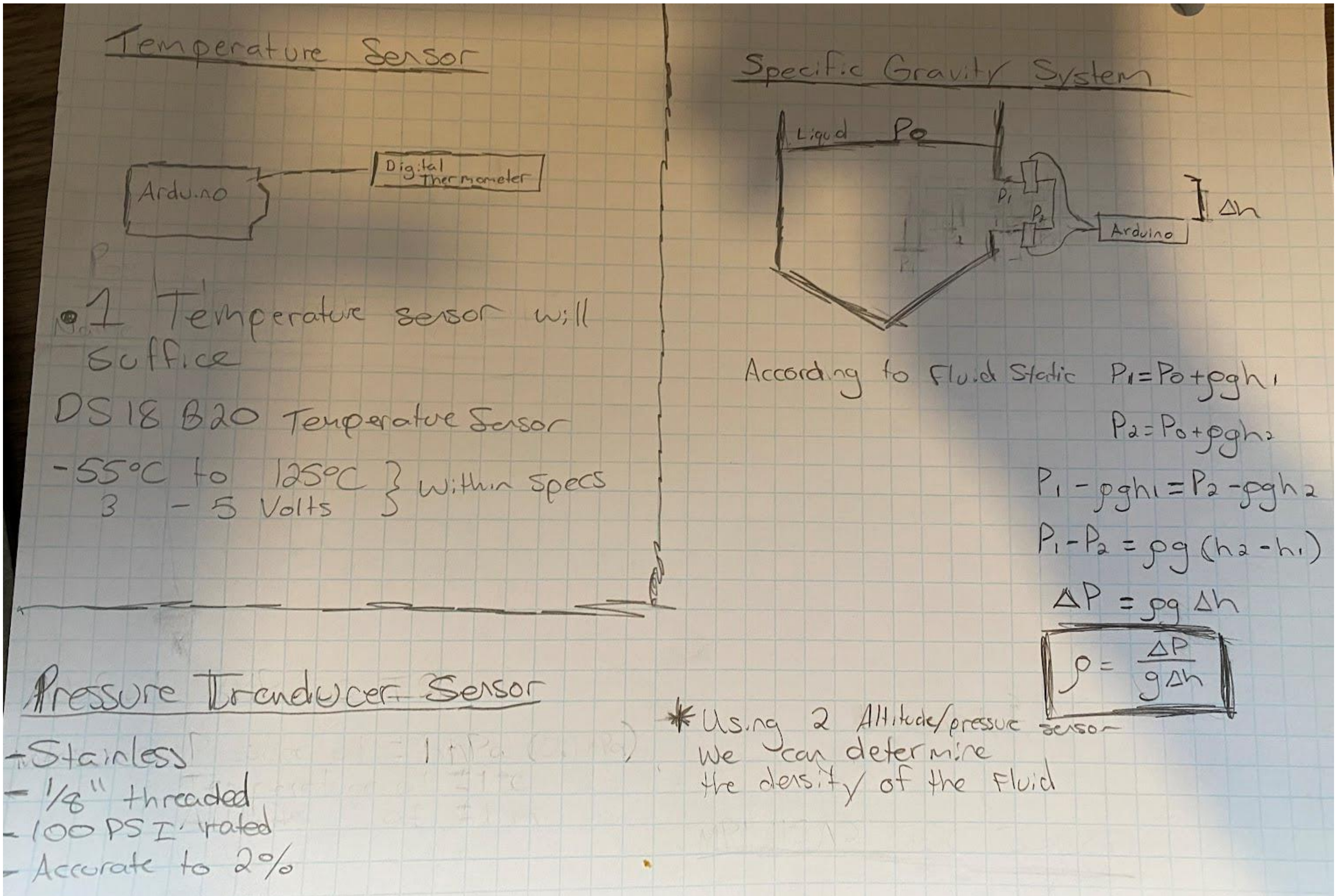
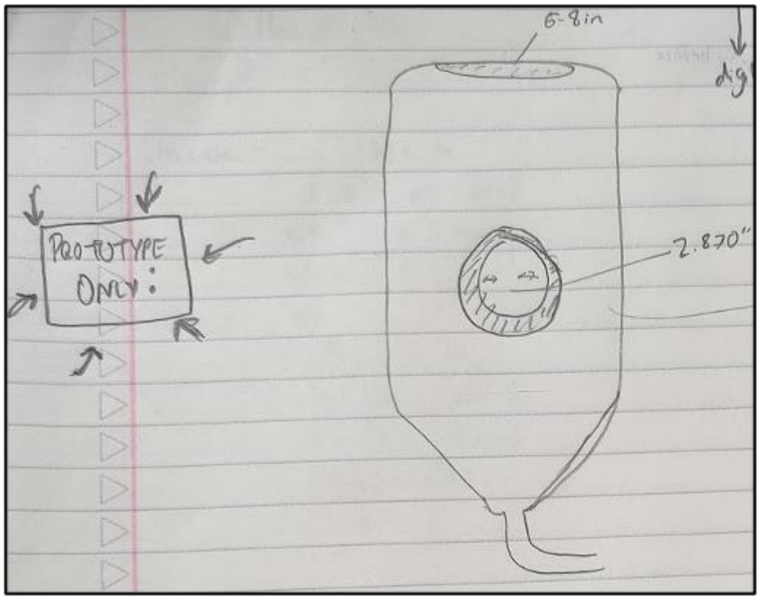
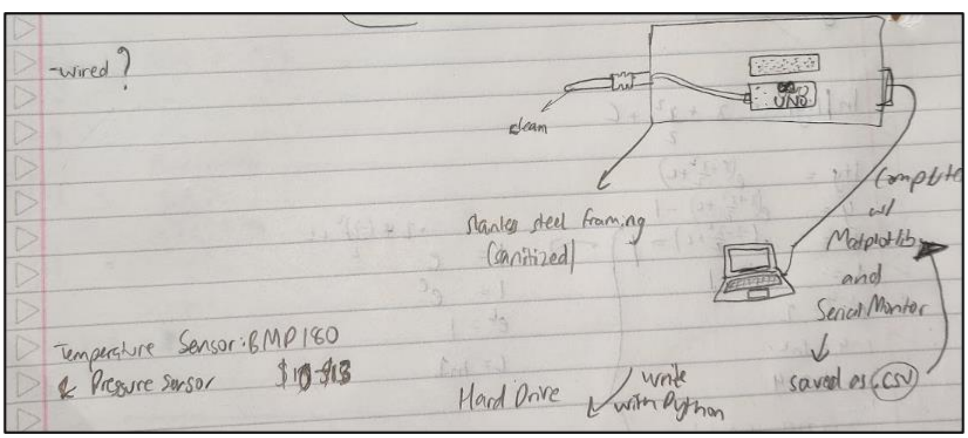


Figure 2: Nick's Temperature and Specific Gravity Subsystem Ideas

Balpreet’s Subsystems Solution:





Temperature Measurement:

Robojax BMP180:

Capable of **both** temperature and pressure measurement. (Even though for the sake of prototyping and saving of costs the DS18B20 temperature sensor in-lab could be used for the prototype)

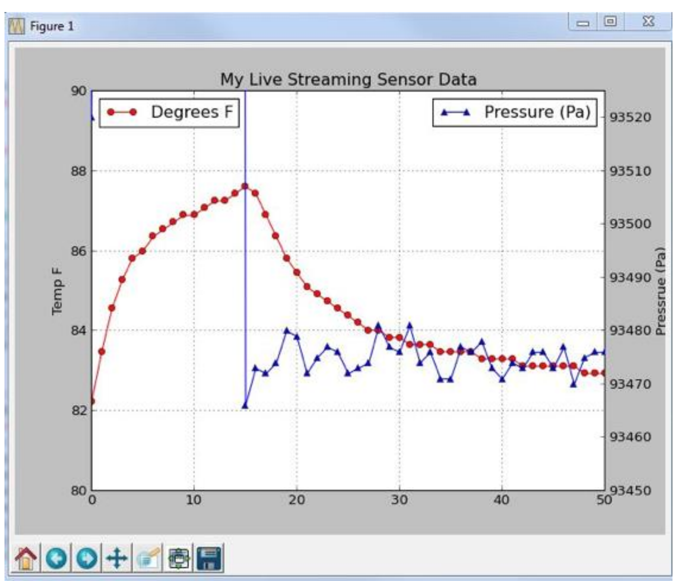
$13.50

- Resolution: Up to 0.03hPa / 0.25m, Operating voltage: 3 to 5VDC
- Pressure sensing range: 300-1100 hPa (9000m to -500m above sea level)
- -40 to +85°C operational range, +-2°C temperature accuracy This board/chip uses I2C 7-bit address 0x77.
- Module size: 13 mm x 10mm x 2.7mm Watch video get Arduino code: http://bit.ly/2N6DLX6

Getting the same from ebay for **$1.37** a piece.

Data Logging:

To be captured with the Arduino Uno board and visualized using Python. Would require the **matplotlib**, **pySerial** and **numpy** libraries for Python, to plot both temperature and pressure data against time, like below:



Using Python, there is also the option to write the captured data onto a .csv file for **offline storage** onto a hard-drive or SD card.

Johann's Subsystem Solutions

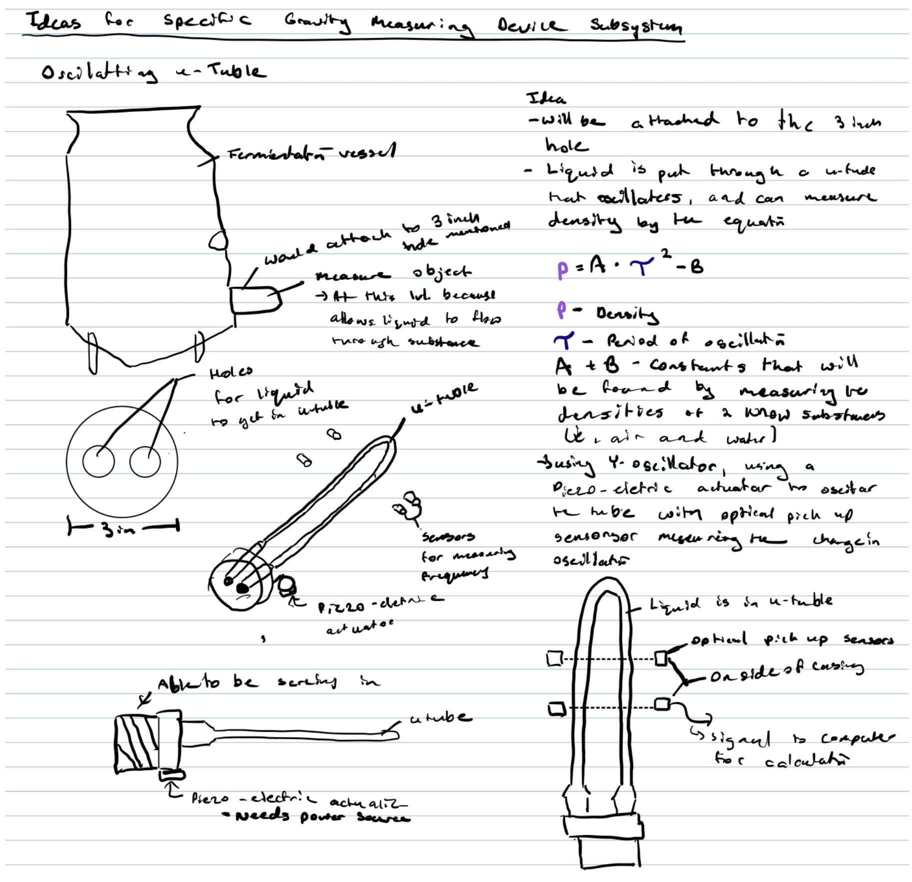
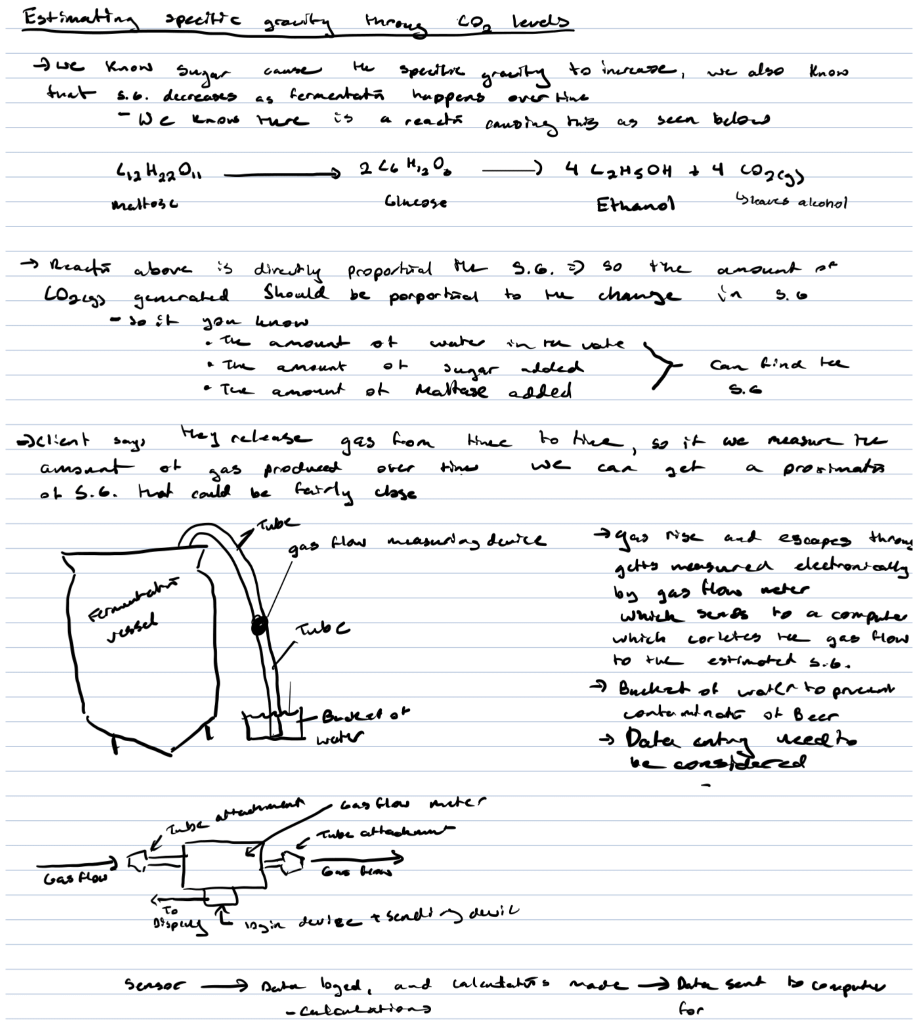


Figure 3: Solution 1 for the Specific Gravity



Estimating specific gravity throug CO_2 levels

→ we know sugar cause the specific gravity to increase, we also know that S.G. decreases as fermentatiō happens over time
- We know there is a reactiō causing this as seen below

$$C_{12}H_{22}O_{11} \longrightarrow 2\,C_6H_{12}O_6 \longrightarrow 4\,C_2H_5OH + 4\,CO_{2(g)}$$

Maltose   Glucose   Ethanol   ↳leaves alcohol

→ Reactiō above is directly proportional the S.G. ⇒ so the amount of $CO_{2(g)}$ generated Should be porportiōal to the change in S.G
- so if you know
  - The amount of water in the vate
  - The amount of sugar added
  - The amount of Maltase added

} Can find the S.G

→ client says they release gas from time to time, so if we measure the amount of gas produced over time we can get a proximatiō of S.G. that could be fairly close

Tube
gas flow measuring device
Fermentatiō vessel
Tube
Bucket of water

→ gas rise and escapes throug gets measured electronically by gas flow meter which sends to a computer which corletes the gas flow to the estimated S.G.
→ Bucket of water to prevent contaminatiō of Beer
→ Data entry need to be considered

Tube attachment
Gas flow meter
Tube attachment
Gas flow
Gas flow
To Display
login device + sends to device

Sensor ⟶ Data loged, and calculatiōs made ⟶ Data sent to computer for
- calculations

Figure 4: Solution 2 for the Specific Gravity

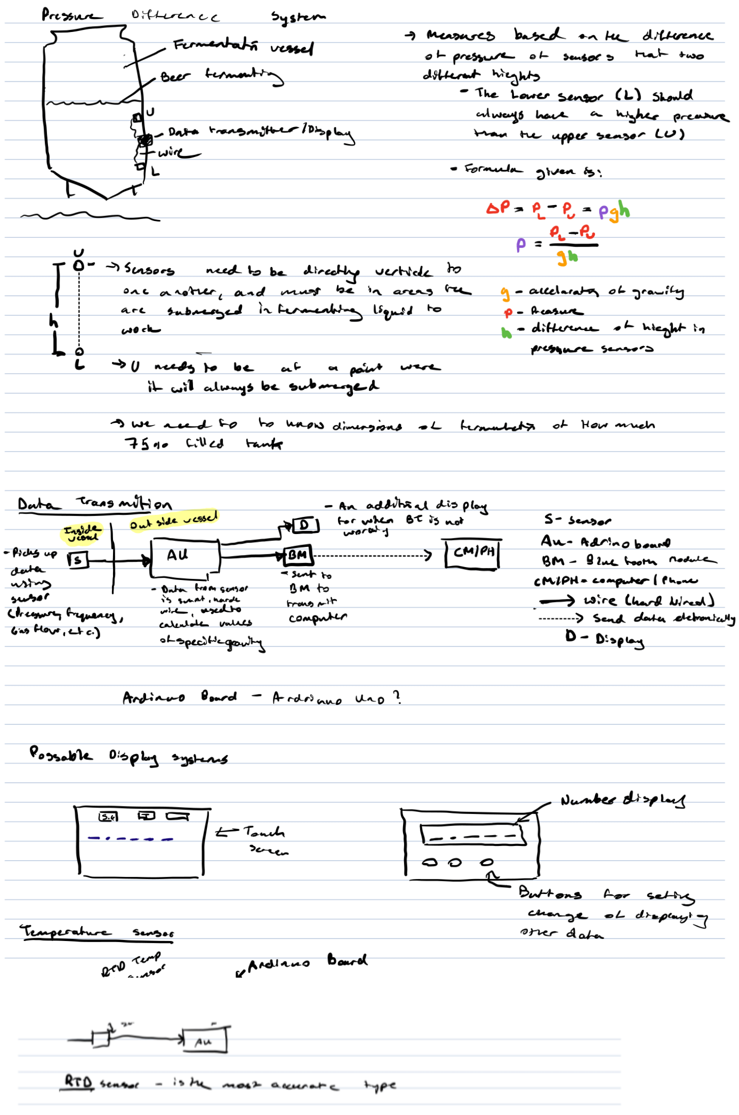


Figure 5: Solution 3 for the Specific Gravity and solution for

Wei’s Subsystem Solutions

Functional Solutions

Solution 1

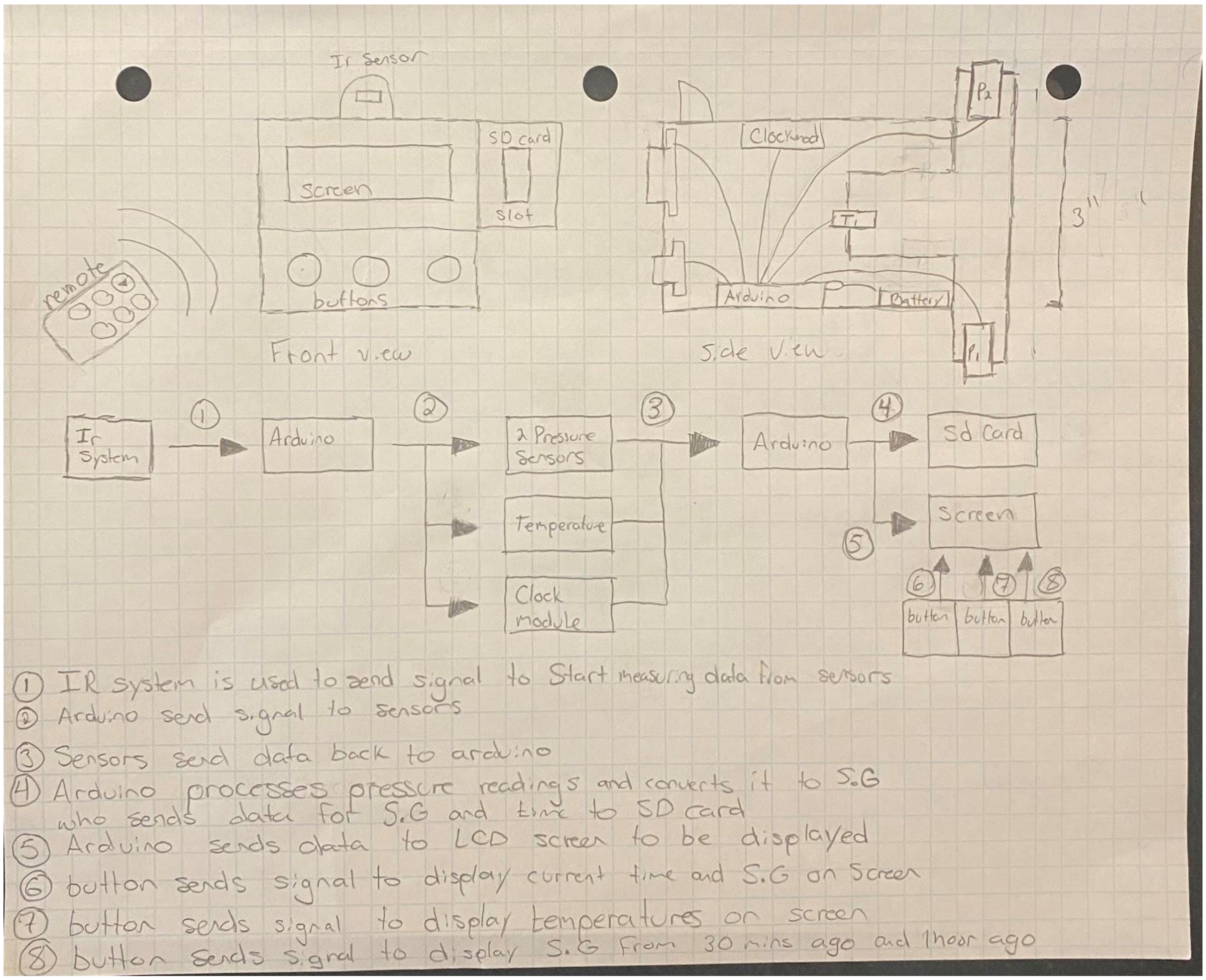


Figure 6: Overall Solution number 1

Table 4: Solution 1 Parts

Parts	Specs
x1 Arduino	• 20$ (Elegoo Board owned)
x1 IR sensor + Remote	• 8 meters Transmission • 28 kHz Transmission • 3.3 or 5 volts
x1 DS18B20 Temperature Sensor	• -55 to 125 ˚C • Stainless Steel Probe
x2 Pressure Transducer Sensor	• Rated for 300 Psi • Stainless Steel • 1/8" threading • 0.04 kg • Good for -40 - 120˚C
x1 Geekstory SD card module	• 2GB Storage • 3$ / piece
x1 LCD Screen + I2c Module	• 20 x 4 Characters • 15$
x1 Clock Module	• 5.40 $ / piece
x1 Battery	• N/a
x3 Buttons (uxcell a12081400ux)	• 1.62$ / piece

Solution 2

The idea of this design is that we measure (estimate) the specific gravity based on how much carob dioxide gas is created during the fermentation process, as the amount of carbon dioxide created is directly proportional to the amount of alcohol made. This process does require inputting known data (such as liquid added, and the amount of sugar in the liquid).

The water bucket is that no contaminates are introduced in the beer. We also know that many of them already release pressure, so it would useful to use the possible tubing they already have to both release the gasses and measure specific gravity.

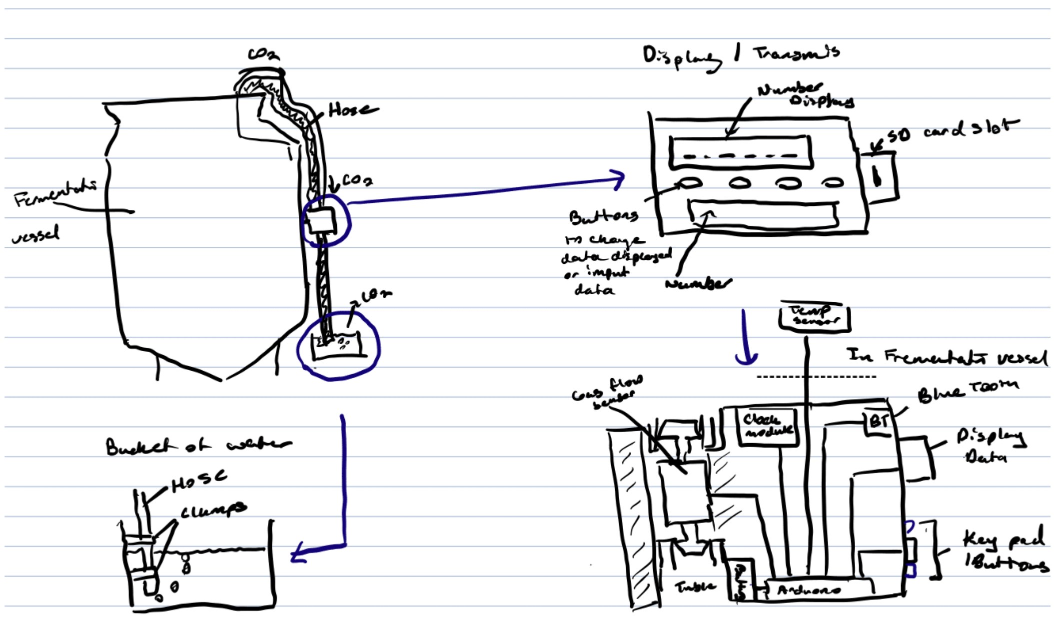


Figure 6: Overall Device design

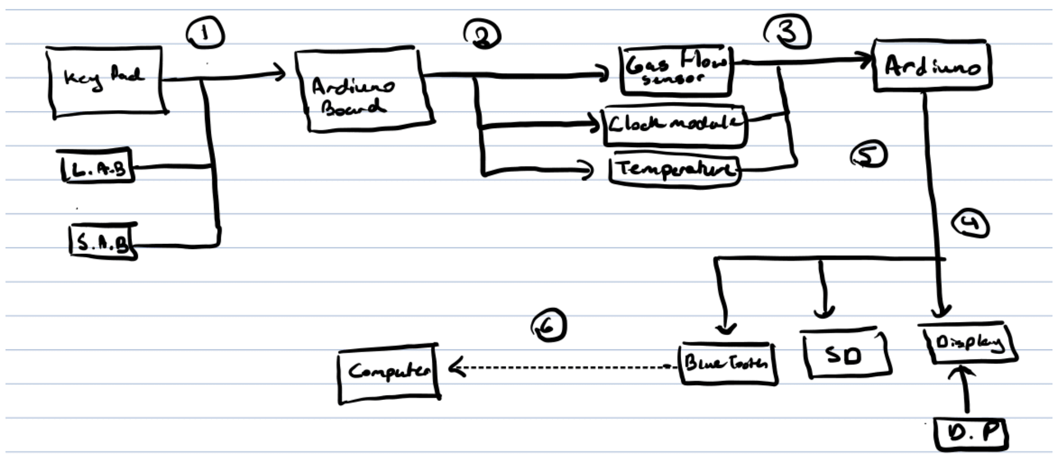
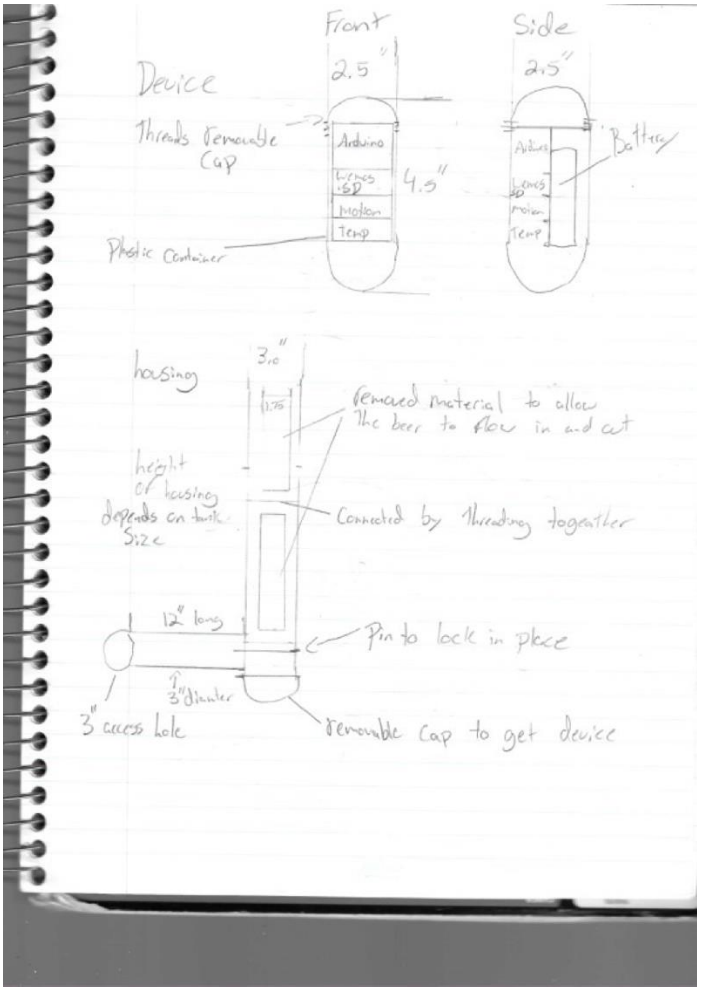


Figure 7: Login System design

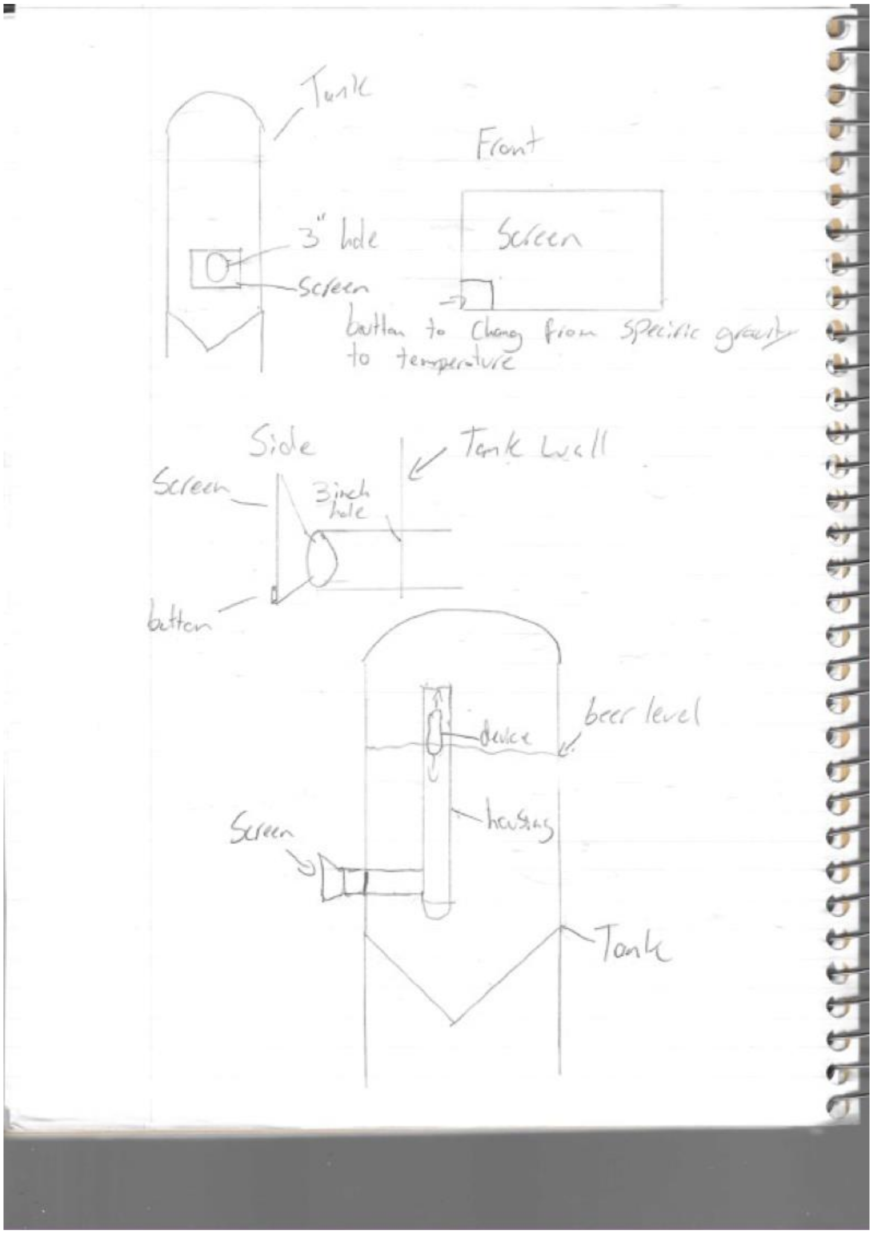
1. Data is entered into system through pressing LAB (Liquid Amount button) and SAB (Amount of sugar/wheat) and entering the data in to through the keypad.
2. This starts the Arduino board to tell the sensors to start running.
3. Sensors sends data to Arduino board that then calculates the SG using inputted data
4. Arduino sends the SG and temperature data to the display where it can be seen by pressing a button

5+6. Data of SG over time is sent to blue tooth module which sends it to the computer for analyzation and the SD card, extra case blue tooth goes down so data is stored safely

Solution 3



Front
Side
Device
2.5"
2,5"
Threads removable Cap
Arduino
Wires SD
4.5"
Motion
Temp
Battery
Plastic Container
housing
3.0"
1.75
removed material to allow the beer to flow in and out
height of housing depends on tank size
Connected by threading together
12" long
Pin to lock in place
3" diameter
3" access hole
removable cap to get device



- The accuracy of this solution is unknow and will need to be tested.
- The device will be fitted with a SD card that can hold up to 1gb of data or the user can upgrade and add an SD card that can hold the desired number of bytes. The device will be able to transmit current readings with WIFI to a web browser which will be uploaded to an excel sheet for graphing and logging of data.
- The housing of the device will be made of 3’’ 40 high temp CPVC piping. That is food friendly. It is also lightweight and cost effective. The device will be in a bottle made from Acrylic (PMMA) because of its light weight and non-toxic properties.
- The housing’s largest diameter will be 3’’ to allow it to be attached to the access point. The hosing will be broken up into 24” long pieces that can be threaded together inside the tank.
- The bottle that the device is placed inside the housing restricting the movement of the device to be only vertically. Not allowing the device to float around the tank freely

- An LCD screen will be placed on the outside of the tank that will show the current results of the device
- A 12’’ shaft will be made so the device can fit closer to the center to get the most accurate readings
- The temperature sensor LM 35 can work within the range of 0 to 75 degrees Celsius as it is rated for -55 to 150 degrees Celsius.
- The LM 35 is accurate to +/- 0.05 degrees Celsius this the desired accuracy of the temperature results
- To clean the device and the housing, it will be removed from the tank and be placed in the food friendly cleaning solution that is already being used by the client.
- To install the device the 12’’ support will be placed inside the tank. The housing will be inserted and threaded together by the 13.5 to 17.5 access hole. The support and housing will be clamped and secured together with a pin to prevent the hosing from falling. The devices will be placed in a cap at the bottom of the housing that will be threaded on. To remove follow process in reverse.

Cost of parts

Part	Cost (CAD)
LM 35	\$2.6
WeMos D1 Mini	\$6.66
Gikfun Gy-521 6 Axis Accelerometer Gyroscope	\$5.00
WeMos D1 SD shield	\$20.00
Arduino Board	\$50.00
1 Gb SD Card	\$10.00
LCD Screen 1.8 inch	\$12.00
Battery	\$5.00
3’’ 40 Hi- Temp CPVC Pipe (85’’)	\$147.00
Device Case	\$5.00
Total	\$263.26

All costs are estimates and prices can vary.

Solution Comparison

Design Specs	Technical Specs	Functional Solution 1	Functional Solution 2	Functional Solution 3
Measuring Specific Gravity	+/- 0.002	+/0.5%	Unknown (must be tested)	Unknow (must be tested)
Run for 14 to 21 Days	21-28	To be tested	Unknown Must be tested	Unknow (must be tested)
Send and Log Data	1 Gb	2 GB SD card	1 GB SD card;	1Gb
Food Safe Material	Yes	Stainless Steel Probes	Yes; Not it is not in contact with product	Yes
Device Dimensions	13.5 by 17.5	Can be modifiable	N/A	3'' diameter
Not Free float	Yes	Yes	Yes	Yes
Out puts results through 3'' hole	Yes	Yes, by screen	No, outside the inter tank	Yes, by a screen
Location in the Tank	1' away from edge	Clamps on to 3" Hole	Outside the tank	1' away from edge
Exposed to high temperatures	up to 75c	Up to 120 C	Wouldn't be exposed to that high of temperatures	-55 to 155c
Cost	$1,562.00	N/a	N/A	$263.26
Temperature accuracy	+/- 0.05c	+/- 0.5 °C	+/- 0.05°C	+/- 0.05c
Screen	Yes	Yes	Yes	Yes
Power is hard wired	Yes	No, Battery powered	No, battery powered	No
Easy to clean	Yes	Yes	Yes	Yes

Easy to use	Yes	Yes	No (need to input already measured data)	Yes
Weight	6.8 kg	Can be modifiable	N/A	Unknow (must be tested)
Easy to remove and install	Yes	Yes	Yes	No
Sample less	Yes	Yes	Yes	Yes
Easy to test prototype	Yes	Yes	No,	Yes

Conclusion

In conclusion, after analyzing 3 possible solutions in accordance with the design criteria outlined in Deliverable C: Design Criteria, we were able to determine that solution number 1 is the ideal solution to tackle Beyond the Pale's design problem because it satisfies more of the design criteria than the other 2 solutions. Solution number 1 has only one drawback, that it is battery powered rather than hardwired. While solution number 2 and 3 have several drawbacks that are not ideal. Some examples of the drawbacks are solution number 3 is not easy to remove or install. Solution number 2 is harder to use as the user must input more data before the device can work. This leaves a greater chance for user error resulting in miss calculations. The last drawback for solution number 2 is that it will be harder to make a prototype to test the accuracy of measuring specific gravity because of the lack of time and money. Therefore, solution number 1 best fits the design criteria made for this problem because it is easy to remove/ install, it is user friendly, and we can easily manufacture a prototype to test the device.

Wrike Link

https://www.wrike.com/open.htm?id=966341779

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