

Deliverable E
Project Plan and Estimate

GNG 1103
Design

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Introduction

In this report, our team will outline the electrical and mechanical parts required in addition to the software required to run our chosen design. A wiring diagram will be provided to provide insight into how our parts will be connected. A CAD model will be provided to provide insight into how our final prototype should look. A bill of materials table will also be provided to show required parts, where we will be getting the parts and will give a cost estimate.

Design

Wiring Diagram

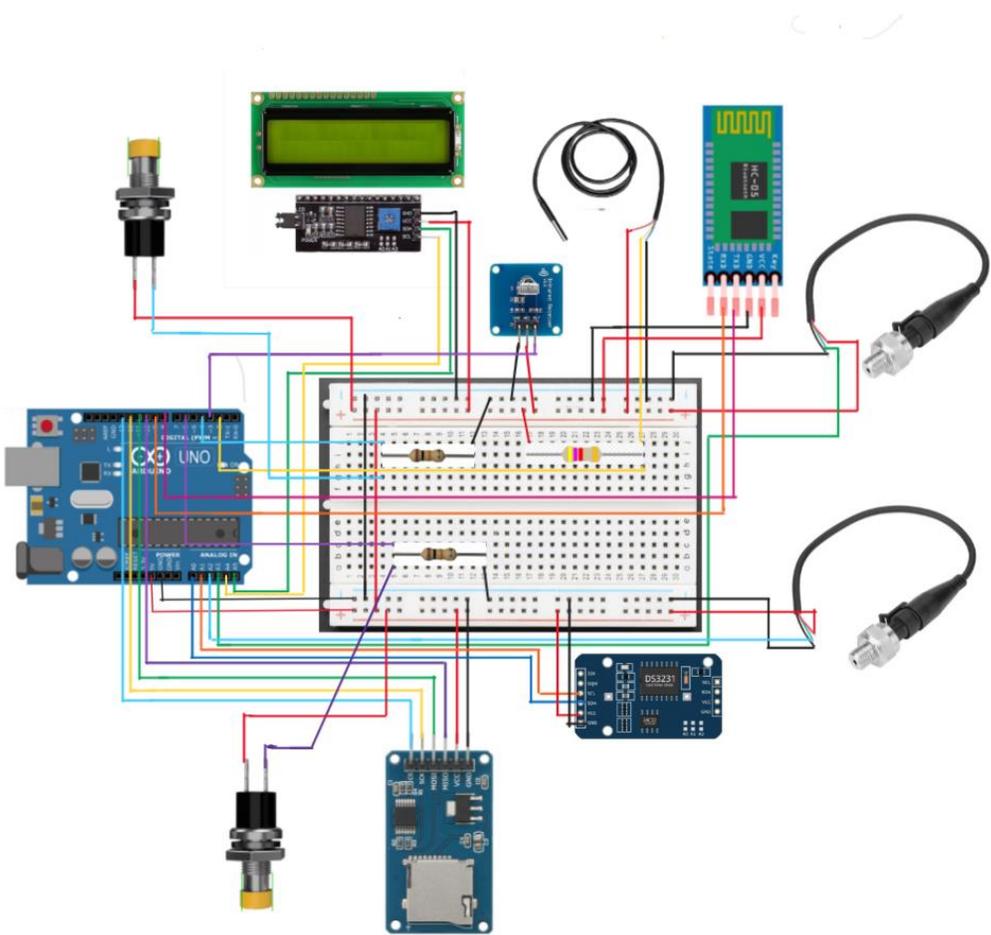


Figure 1: Electrical Wiring Diagram

CAD Design

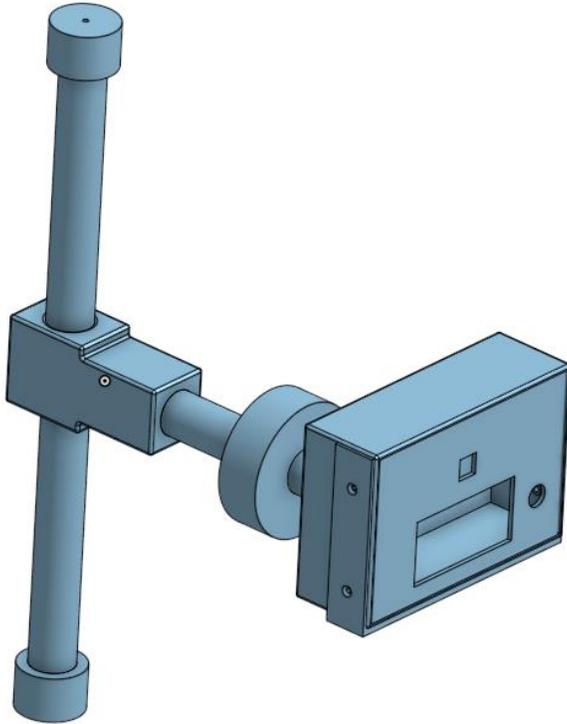


Figure 2: Fully Assembled Design

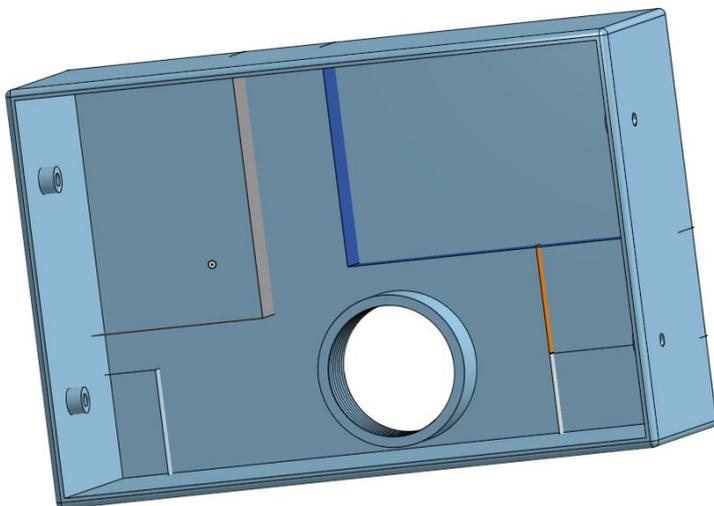


Figure 3: Electrical Compartment box Interior

OnShape Link:

<https://cad.onshape.com/documents/af61c870444ddbe89ff03be3/w/d489ea27f3e4bdf3322c304f/e/77337e5b5664df97792dd1cc?renderMode=0&uiState=63555f6e6b23cf60326636e>

Bill of Materials

Table 1: Bill of Materials

Parts	Quantity	Unit of Measure	Unit Cost (\$)	Estimate Cost (\$)	Link
Hardware Required					
Mil. Spec Aluminum Tubing 1OD 1ft Length	2	FT	0	0	Owned
Aluminum Rod 1-5/8 Dia 1ft Length	1	FT	0	0	Owned
Aluminum 2x6x1-1/2	1	EA	0	0	Owned
Food Grade Silicone Sealant	1	EA	0	0	Owned
3D printed Electrical Compartment Bottom	1	EA	0	0	MakerLab (to be printed)
3D printed Electrical Compartment Top	1	EA	0	0	MakerLab (to be printed)
O-Rings	6	EA	0	0	Owned
Screws	8	EA	0	0	Owned
Electrical Components Required					
Arduino	1	EA	0	0	Owned
Breadboard	1	EA	0	0	Owned
LCD Screen	1	EA	0	0	Owned
I2C Module	1	EA	3.04	3.04	See Links Section
Pressure Transducer Sensor 30 Psi	2	EA	13.49	26.98	See Links Section
Micro SD adapter	1	EA	2.5	2.5	See Links Section
SD Card (16 GB)	1	EA	7	7	See Links Section
Latching Buttons	1	EA	0.54	0.54	See Links Section
Bluetooth connection	1	EA	12.99	12.99	See Links Section
DS18B20 Temperature Sensor	1	EA	4	4	See Links Section
IR Sensor	1	EA	0	0	Owned
Clock Module	1	EA	2	2	See Links Section
Remote	1	EA	0	0	Owned
4.7 K Ω Resistor	1	EA	0	0	Owned
10 K Ω Resistor	2	EA	0	0	Owned

9V 1A power Adapter	1	EA	14.99	14.99	See Links Section
Software Required					
Arduino IDE	1	EA	0	0	Owned
OnShape	1	EA	0	0	Owned
Python	1	EA	0	0	Owned
Libraries					
Liquid Crystal	1	EA	0	0	See Links Section
OneWire	1	EA	0	0	See Links Section
Spi	1	EA	0	0	See Links Section
DS3231	1	EA	0	0	See Links Section
DallasTemperature	1	EA	0	0	See Links Section
Irremote	1	EA	0	0	See Links Section
Software Serial	1	EA	0	0	See Links Section
SD	1	EA	0	0	See Links Section
Total Cost (Without Tax)				74.04	
Total Cost (With Tax)				83.67	

Link to Google Spreadsheet containing full Table 1: Bill of Materials -

https://docs.google.com/spreadsheets/d/1HLeKHimS2K6xT5xADkeC8T_iUnEW0eZaAFPuYZtyU8s/edit#gid=0

Links

Part Links

I2C Module: https://www.amazon.ca/LCD1602-Converter-Interface-Display-Arduino/dp/B0924RND6X/ref=sr_1_3?crid=3EU4551AO1WZ7&keywords=i2c+module+interface+lcd&qid=1666459154&qu=eyJxc2MiOilxLjU5IiwicXNhIjoiMC4wMCIsluFzcCI6IjAuMDAifQ%3D%3D&s=industrial&sprefix=%2Cindustrial%2C173&sr=1-3

Pressure Transducer: https://www.amazon.ca/Thread-Stainless-Pressure-Transducer-Compatible/dp/B08G4ZX4LY/ref=sr_1_11?keywords=pressure%2Btransducer&qid=1666567830&qu=eyJxc2MiOilzLjk5IiwicXNhIjoiMy4yNiIsInFzcCI6IjluNTAifQ%3D%3D&s=industrial&sprefix=Pressure%2BTrans%2Cindustrial%2C153&sr=1-11&th=1

Micro SD Adapter: <https://edu-makerlab.odoo.com/shop/product/microsd-adaptor-26#attr=>

SD Card: <https://edu-makerlab.odoo.com/shop/product/micro-sd-card-168#attr=360>

Latching Button: <https://edu-makerlab.odoo.com/shop/product/push-button-switch-81#attr=148>

Bluetooth Module: https://www.amazon.ca/DSD-TECH-SH-HC-08-Transceiver-Compatible/dp/B01N4P7T0H/ref=sr_1_1_sspa?gclid=Cj0KCQjwqc6aBhC4ARIsAN06NmP2fSIIm97NTqqza7FSTFgNi815wPT2iGeaKDSU7pZpECi7JWlImYQaAvBGEALw_wcB&hvadid=588883190336&hvdev=c&hvlocphy=9000702&hvnetw=g&hvqmt=e&hvrnd=9044267381163623053&hvtargid=kwd-298511473808&hydacr=4677_13204995&keywords=hc+05+bluetooth+module&qid=1666469835&qu=eyJxc2MiOilxLjUwliwicXNhIjoiMS44MSIsInFzcCI6IjEuNTYifQ%3D%3D&sr=8-1-spons&psc=1

DS18B20 Temperature Sensor: https://www.amazon.ca/Cylewet-DS18B20-Temperature-Digital-Waterproof/dp/B07DDHJYXT/ref=sr_1_7?keywords=arduino+temperature+sensor&qid=1666457445&qu=eyJxc2MiOil0LjAyliwicXNhIjoiMy41MSIsInFzcCI6IjMuMDcifQ%3D%3D&s=industrial&sprefix=arduino+te mp%2Cindustrial%2C113&sr=1-7

Clock Module: https://www.amazon.ca/DAOKI-Arduino-AT24C32-Precision-Compatible/dp/B07XB2265S/ref=sr_1_2_sspa?crd=1LM14RR1BMQTP&keywords=clock+module+ardui no&qid=1666469963&qu=eyJxc2MiOilxLjE3liwicXNhIjoiMC4wMCIsInFzcCI6IjAuMDAifQ%3D%3D&sprefi x=clock+module+arduino%2Caps%2C176&sr=8-2-spons&psc=1&smid=A30Y6WWS77DGEW

Wall Adapter: https://www.amazon.ca/Designed-Arduino-Adapter-Support-Leonardo/dp/B09VSH22Z3/ref=sr_1_1_sspa?crd=UG341BG9H4W1&keywords=power+adapter+arduino &qid=1666470067&qu=eyJxc2MiOilxLjg3liwicXNhIjoiMC4wMCIsInFzcCI6IjAuMDAifQ%3D%3D&sprefix= power+adapter+arduino%2Caps%2C154&sr=8-1-spons&psc=1

Library Links

Liquid Crystal: <https://www.arduino.cc/reference/en/libraries/liquidcrystal/>

OneWire: <https://www.arduino.cc/reference/en/libraries/onewire/>

Spi: <https://www.arduino.cc/reference/en/language/functions/communication/spi/>

DS3231: <https://www.arduino.cc/reference/en/libraries/ds3231/>

DallasTemperature: <https://www.arduino.cc/reference/en/libraries/dallastemperature/>

Irremote: <https://www.arduino.cc/reference/en/libraries/irremote/>

Software Serial: <https://docs.arduino.cc/learn/built-in-libraries/software-serial>

SD: <https://www.arduino.cc/reference/en/libraries/sd/>

Prototype Testing Plan

Table 2: Prototype Testing Plan

ID	Test Objective	Description of Prototype	Results to be Recorded	Duration of Test
1	Determine Accuracy of Pressure Sensors	Our 2 pressure sensors will be connected to an Arduino and be tested in different liquids of known density at different heights to test accuracy	1.Height of completed test 2.Fluid used 3.Temperature of fluid 4.Difference from theoretical value	Test will last until we are within our design spec accuracy
2	Determine Capacity of Storage	Our SD Card adapter will be connected to the Arduino which the 2 pressure transducers. We will run 2 tests of 2 different duration to extrapolate how much time it would take to fill the SD card	1.Duration of Test 2.How much data was stored	The first test will be for 1 hour. The second test will be overnight for 8 hours.
3	Determine if screen displaying correct results	Our 2 pressure sensors and the LCD screen will be connected to the Arduino. We will display our result on the serial monitor and the screen to see if they are the same	1.Recording pressure on the serial monitor 2.Recording pressure on LCD screen	Test will last till serial monitor and LCD screen have the same number
4	Determine if button works correctly	The LCD screen and the button will be connected to the Arduino. We will display a message on the screen and see if we can switch it to a second prescribed message using the button	1.Time it takes to switch between messages 2.If the correct message is showing	Test until message is switching correctly
5	Determine if IR sensor work	The IR sensor will be connected to the Arduino. We will see if the IR sensor is receiving commands from the remote. The serial monitor will be used to check if it is working.	1.Command being seen in the serial monitor	Test until correct command is being seen on serial monitor
6	Determine if Temperature sensor is working	The temperature sensor will be connected to the Arduino and the temperature will be shown on the serial monitor. We will use a thermometer to check result	1.Temperature on Serial Monitor 2.Temperature of thermometer	Test until thermometer and sensor are withing design spec

Risks and plans

1. The Bluetooth might be interrupted because of numerous signals being sent through Beyond the Pale's Brewery.
 - a. We have SD card extra in case Bluetooth does not work
 - b. If we cannot get the Bluetooth to work, we will hardwire the system to computer instead.
 - c. We will test the Bluetooth profusely throughout the entire project
2. The IR system may cause issues if the small remote is lost.
 - a. We will replace the IR sensor with a button instead to start the measurement data.
3. The tube for pressure sensors and wires to the pressure might leak.
 - a. We will use sealant to make sure it is waterproof
 - b. We will change the materials of the tubing to make casing more waterproof if materials then what we originally were using
4. All the hardware needs to be able to work for more than 25 days (especially battery and sensors)
5. The accuracy of pressure sensors is not tested yet, we need to make sure the specific gravity is the same for all heights.
 - a. We will re-take exact measurements of the distance between the pressure sensors.
 - b. The measurements of the temperature will be retaken with as much accuracy as possible
 - c. The equations of the specific gravity will be checked to make sure that there is no mathematical error.
6. The IR sensor might have a short range for receiving commands from the remote.
 - a. We can replace the IR sensor with one that has a longer range
7. It is not sure if 16 GB SD card is enough space to hold all the data for 28 days.
 - a. We will change the SD card to a higher storage capability.

Project Plan

Our project plan for the remaining weeks is to prototype every single different sensor/module separately to ensure all parts are working correctly. For the second prototype, we will combine all sensors/module to ensure the system works correctly and finally, for the third prototype, we will combine prototype 2 with all the hardware to put out our final prototype. Please see Wrike for a more in-depth view of our task, timelines, and dependencies.

Wrike Link:

<https://www.wrike.com/workspace.htm?acc=4975842&wr=20#folder/966341779/list?filters=status%3Dactive&sidePanelItemId=969519153&sortOrder=1&spaceId=-1&viewId=108931260>