DesignOtt Engineers Inc.

PROJECT PLAN & COST ESTIMATE

GNG1103, Section # F, Team # F3

Yusra Hasib
Gurshaan Grewal
Ahmad Muslat
Sendwe Mutantabowa
Lauren Olszaniecki

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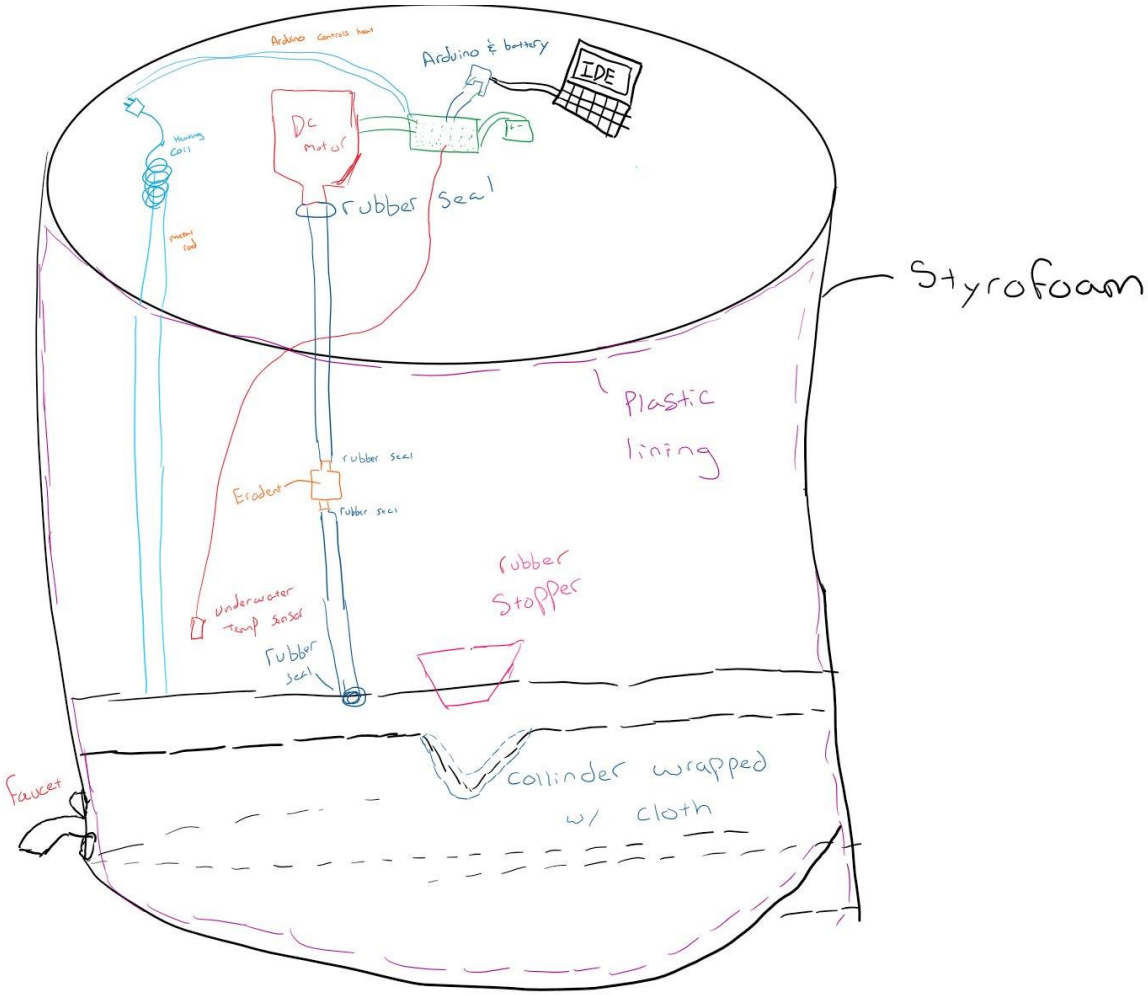
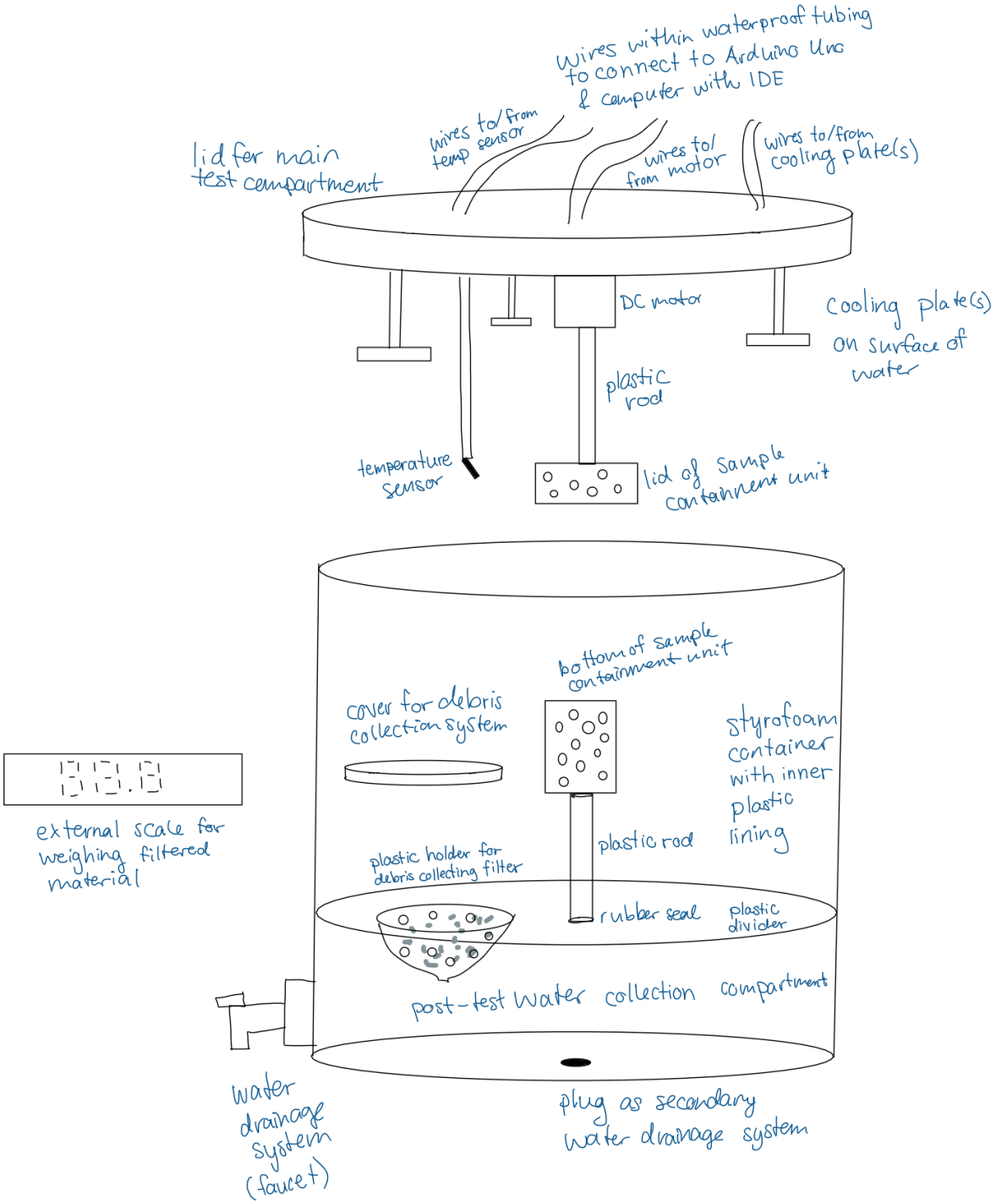
1.0 Drawing Design

1.1 Initial Diagram



1.2 Refined Prototype



2.0 List of Tasks to be Completed

Task	Description	Name	Due Date
Acquire some raw materials	Order and bring Arduino, breadboard, wires, DC motor, and temperature sensors to campus.	Lauren	February 27
Write Arduino DC motor code	Write code to turn motor.	Yusra	February 27
Propellor	Design and print small scale propellor (for testing purposes).	Yusra	February 27
Container modeling	Design full-scale and small-scale plastic container, and 3D print small-scale container and lid (for testing purposes).	Sendwe	February 27
Sample containment	Design and 3D print full size sample containment lid and bottom.	Gurshaan	February 27
Write Arduino temperature control code	Write code to turn on power to cooling system when water temperature is above a certain threshold.	Ahmad	February 28
Acquire further raw materials	Order and bring insulator, container, and coffee filters.	Lauren	February 28
Prototype I	Combine successful subsystems to make an initial prototype.	All	March 3
Improve subsystems and implement additional requirements	If some subsystems were not included in the first prototype, install them and refine the ones that did not work.	All	March 3-10
Prototype II	Construct the second prototype.	All	March 10
Find a place to begin the erosion test	Look around campus and ask professor where to run test.	Yusra	March 10
Solder PCB	From wiring scheme determined from previous prototype, solder the PCB connections.	Lauren	March 11
Propellor	3D print full size propellor.	Ahmad	March 12
Construct lid	Connect Arduino, circuit board, temperature sensors, cooling system, DC motor, and rod.	Yusra	March 14
Construct drainage system	3D print drainage system with filter & bottom of sample containment unit, filter cover, and plug for stopping water leakage.	Gurshaan	March 16
Install drainage system into container	Secure the 3D printed system into the test container.	Sendwe	March 17
Install sample containment unit	3D print and fit lid onto bottom of sample containment unit.	Lauren	March 18
Begin test	Set up system and power to motor.	All	March 19

Check on test	Confirm daily that the test is still running successfully.	All	March 19-
Prototype III	Construct the third prototype.	All	March 24
Minimal changes	Perform maintenance and change small details as needed while test is running.	All	March 24-
Calculations	Do calculations to find the expected time to erode based on the speed of the water and amount of force that the water is exerting on the eroding material.		April 2
Final Product	Construct the final product.	All	April 3
Design Day Presentation	Generate PowerPoint showcasing the final product. Its construction, the steps taken to complete it and everything else attached to the process.	All	April 4
User and Product Manual	Type out manual, complete with everything needed to know about the product and how to operate it properly.	All	April 10

3.0 Project Risks

Risk	**Severity** (High, Moderate, Low)	**Likelihood** (High, Moderate, Low)	**Contingency Plan**
Materials not available	High	Moderate	Search other locations for materials
3D printing errors	Moderate	High	Use a different 3d printer or a different type of printer in the MakerSpace; or buy the components
Arduino not working	High	Low	Temporarily borrow Arduino
Water leakage	Moderate	High	Hot glue in the cracks
Styrofoam falling apart	Moderate	Moderate	It is likely for it to fall apart afer a few uses so a water jug made of plastic is better for long term use and cost wise.
Data being lost	Moderate	Low	Backup everything and Arduino on a USB after each test or have multiple people half ownership of the file.
Filter fails	Moderate	Low	Check filter after every test and even change so buy a pack of coffee filters
Scale fails	High	Moderate	Set scale to zero before use.
Plug fails to hold liquid and due to	High	Moderate	Ensure lid is properly screwed in prior to use and ensure it is not faulty since we will be 3D printing it.

pressure pops open by itself			
Temperature sensor fails	Moderate	Low	Replace regularly and check accuracy prior to test

4.0 Project Cost Spreadsheet

Item	Purpose	Cost per Unit ($)	Quantity	Subtotal ($)
Arduino Uno Rev3	Controlling the sensor, motor, and cooling components	15.25	1	15.25
12V DC Motor	Rotate propellor to agitate water	1.99	1	1.99
Solderless Breadboard	Prototyping	5.00	1	5.00
Printed circuit board	Connecting Arduino to sensors, motors, & cooling components	2.33	3	7.99
20cm male to male wires	Connect circuitry	0.10	10	1.00
N-channel power MOSFET	Allow power transfer	1.95	1	1.95
USB A to USB B Cable for Arduino Uno	Connecting computer to Arduino	0.20	1	0.20
AAA Battery	Power DC motor	1.00	3	3.00
220 ohm resistor	Set up circuitry	0.95	1	0.95
Waterproof digital temperature sensor	Measure temperature	4.33	3	12.99
Cooling components	Remove thermal energy from water	3.75	4	15.00
Battery pack	Connect battery to Arduino and motor	2.50	1	2.50
Plastic rod	Support motor with propellor to spin water, and support sample containment unit	0.00	2	0.00
Propellor	Agitate water during erosion test	0.00	1	0.00
Coffee filter	Filter the eroded elements from the water	0.02	200	3.98
Easily eroding rocks	Produce quanitifable results in a shorter timespan than eroding plastic	5.49	1	5.49
Scale	Measure weight of filter containing eroded material	13.99	1	13.99
Sample containment unit	Contain eroding material	0.00	1	0.00

Compartment separator with built in filter	Prevent water from draining out before test is complete	0.00	1	0.00
Water jug	Contain the setup of the system	19.10	1	19.10
Aluminum foil roll	Prevent heat entering the test setup by insulating	1.97	1	1.97

SUBTOTAL: cost before tax = 112.35

FINAL COST: subtotal x 1.13 = 126.96

4.1 Reference Table for Costs

Product Name	**Link**
Arduino Uno Rev3	https://makerstore.ca/shop/ols/products/arduino-uno-r3-clone
12V DC Motor	https://makerstore.ca/shop/ols/products/compact-dc-hobby-motor
Solderless half breadboard	https://makerstore.ca/shop/ols/products/breadboard/v/C005-HLF
Printed circuit board	https://makerstore.ca/shop/ols/products/smt-breakout-pcb-for-soic-28-or-tssop-28-3-pack
20cm male to male wires	https://makerstore.ca/shop/ols/products/jumper-cables-pack-of-10/v/C004-20-MM
N-channel power MOSFET	https://makerstore.ca/shop/ols/products/n-channel-power-mosfet-30v-60a
USB A to USB B Cable for Arduino Uno	https://makerstore.ca/shop/ols/products/usb-type-a-b-cables
AAA Battery	https://makerstore.ca/shop/ols/products/aaa-battery-single
220 ohm resistor	https://www.pishop.ca/product/resistor-220-ohm-14w-5-axial-pack-of-10/
Waterproof digital	https://www.amazon.ca/Bolsen-Digital-Temperature-Thermometer-Waterproof/dp/B07HQ75RPP/ref=sr_1_39

temperature sensor	
Cooling components	https://electropeak.com/12v-tec1-12709-thermoelectric-cooler
Battery pack	https://makerstore.ca/shop/ols/products/3-x-aaa-battery-holder-with-on-off-switch-and-2-pin-jst
Coffee filter	https://www.walmart.ca/en/ip/melitta-basket-coffee-filters-10-12-cups-white/6000188868142
Easily eroding rocks	https://canada.michaels.com/en/mini-landscape-rocks-by-make-market/10260230.html
Scale	https://www.amazon.ca/NEXT-SHINE-Weighing-Function-Stainless-Platform/dp/B017LUWCAW/
Water jug	https://www.uline.ca/Product/Detail/S-16915/Jugs/F-Style-Jugs-5-Gallon-Natural?pricode=YJ576&gadtype=pla&id=S-16915&gad_source=1&gclid=CjwKCAiA_tuuBhAUEiwAvxkgTn08BT65y3ST-_CWhkFBJYBJjcHYExmYZbjUcDKp9pftsqNh65yGgxoCDr0QAvD_BwE
Aluminum foil roll	https://www.walmart.ca/en/ip/great-value-aluminum-foil/10270023

5.0 Prototyping Test Plan

Test ID	Test Objective	Description of Prototype used and of Basic Test Method	Description of Results to be Recorded and how these results will be used	Estimated Test Duration and Planned Start Date
1	Analyze the overall containment and drainage	Set up the containment system with the fluid and the drainage system in a small-scale model	Qualitative results: whether all the fluid drains out without any remaining inside the container. If not, the design should be modified	15 minutes (10 minutes to fill and 5 to drain). February 26th
2	Test the rotation	Run the Arduino connected to the motor and rod	Any visual or audible signs of fatigue of the motor after 20 minutes of running. If so, a new motor will be selected	30 minutes March 1st
3	Analyze and test how long and how easy it is to install the sample	Generate sample containment unit top and bottom and connect to rod	Sizing of sample container top and bottom. If it doesn't fit together, the CAD model will be modified. Time required for sample installation. If it takes more than 2 minutes, the CAD model will be simplified	10 minutes March 6th
4	Assess the physical components of the cooling system	Connect components to an Arduino and set up the components as per the prototype, in a somewhat insulated environment. Test when all cooling components are engaged, 50% of cooling components are engaged, and 0% are engaged	Over the course of 20 minutes, measure temperature every 5 minutes (5 measurements in total per sub-test). Recorded temperature values will be analyzed. If fluid temperature continues to increase when all components are engaged, add more cooling coils to the final design	1 hour March 8th
5	Adjust rotation speed while motor in operation	Run the Arduino connected to the motor and rod while changing values of speed in the Arduino IDE	Qualitative results: See if the rotation of the blade changes as expected.	10 mins March 12th