Deliverable F

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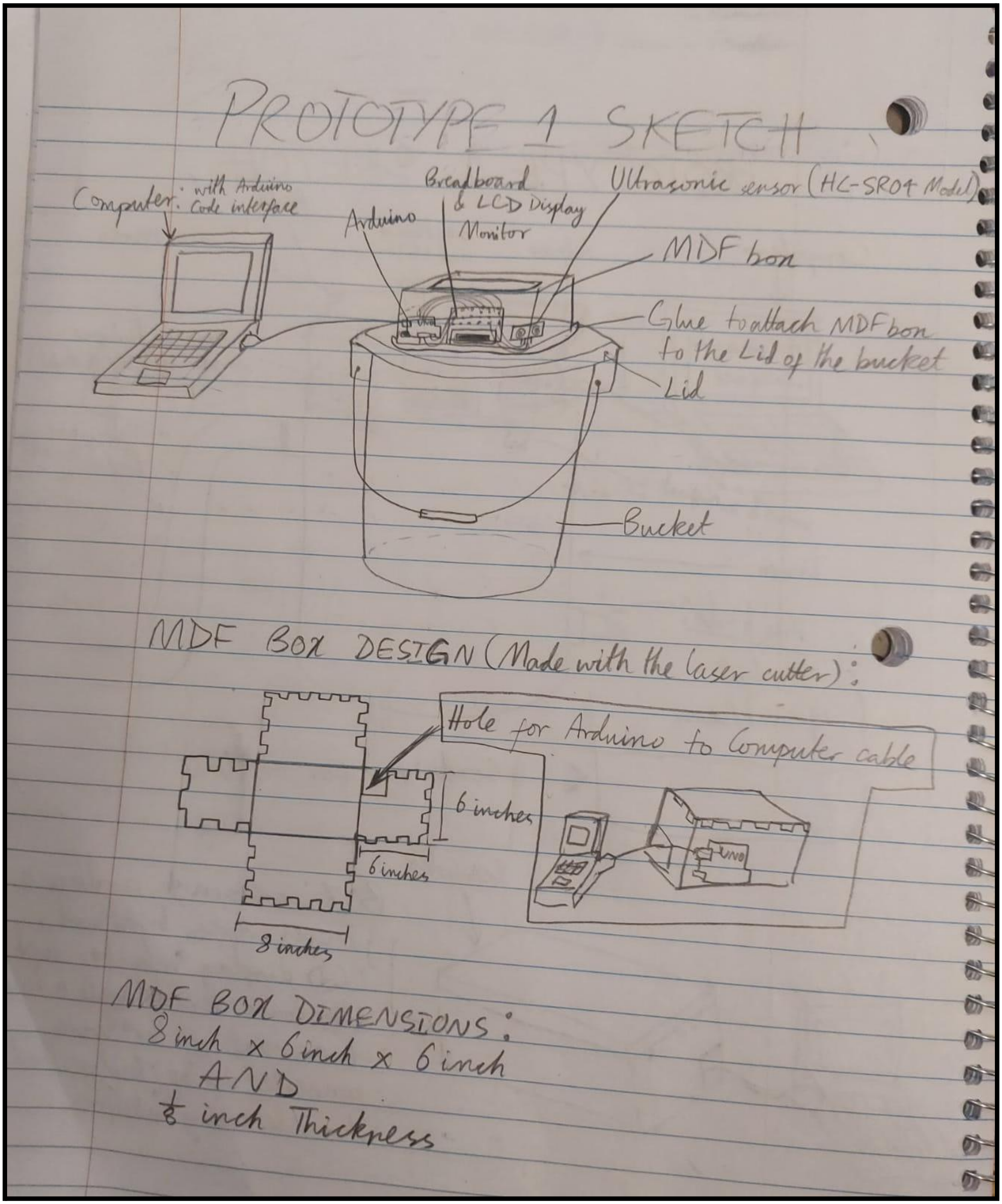
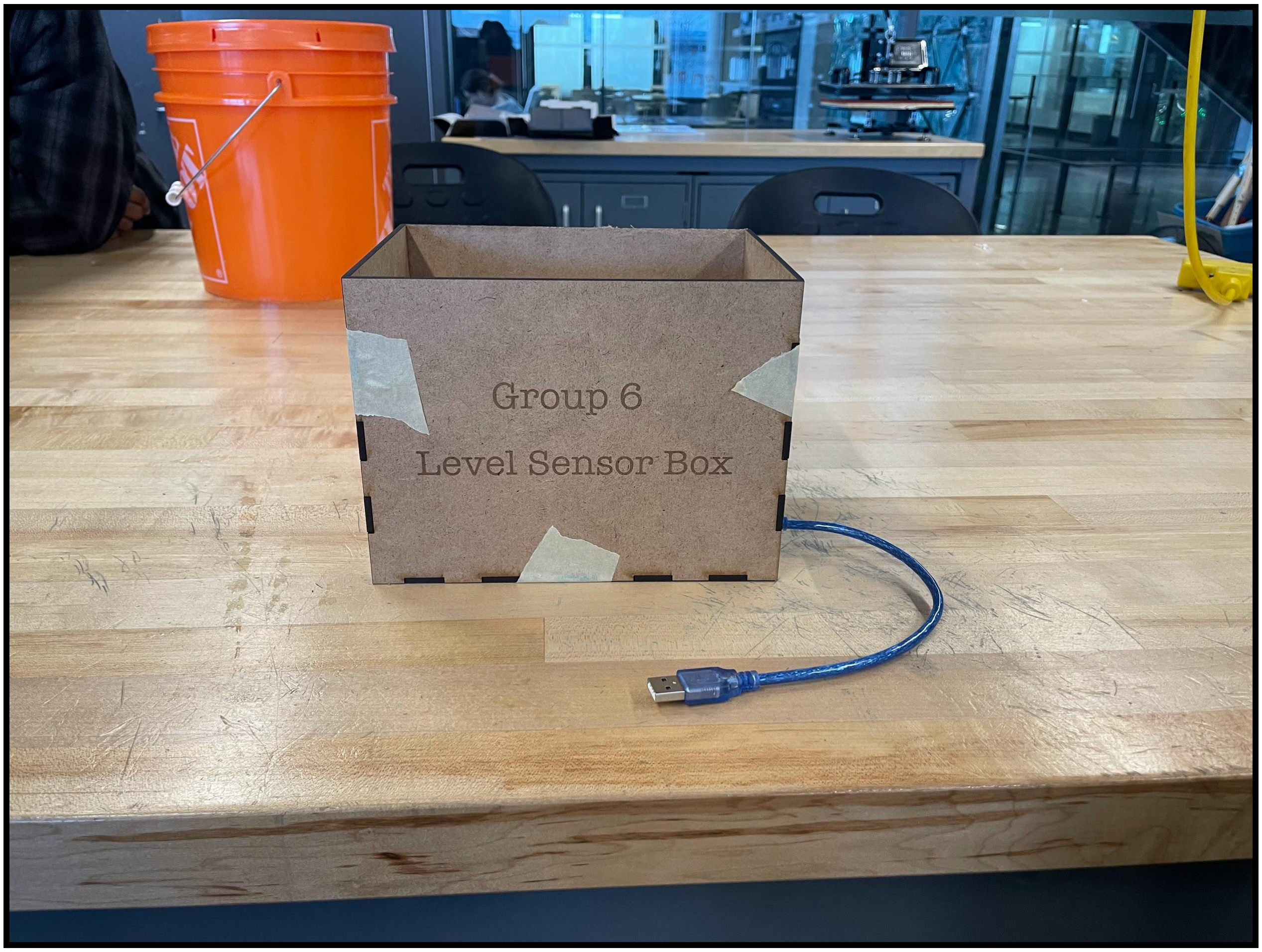
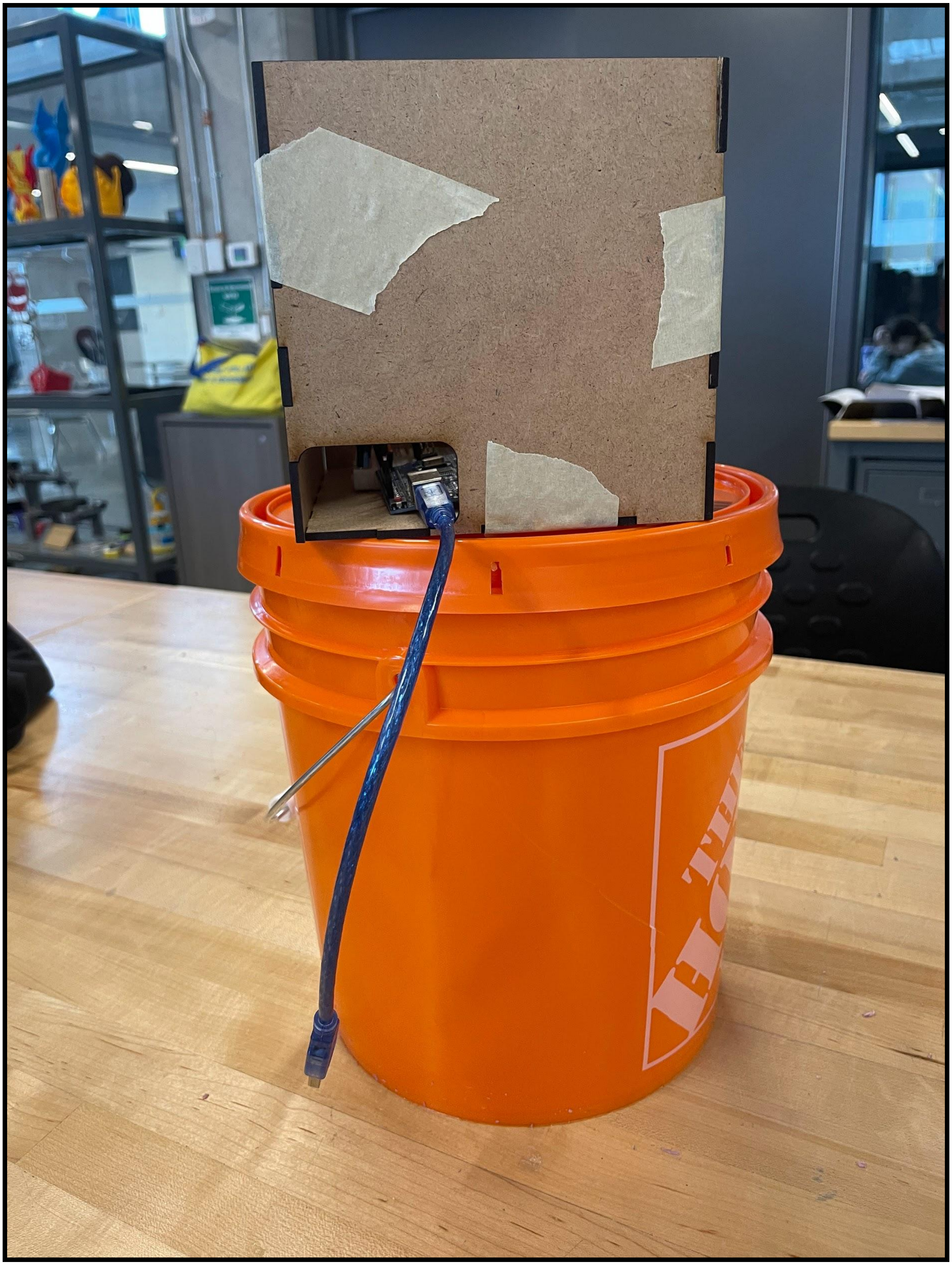
PROTOTYPE 1

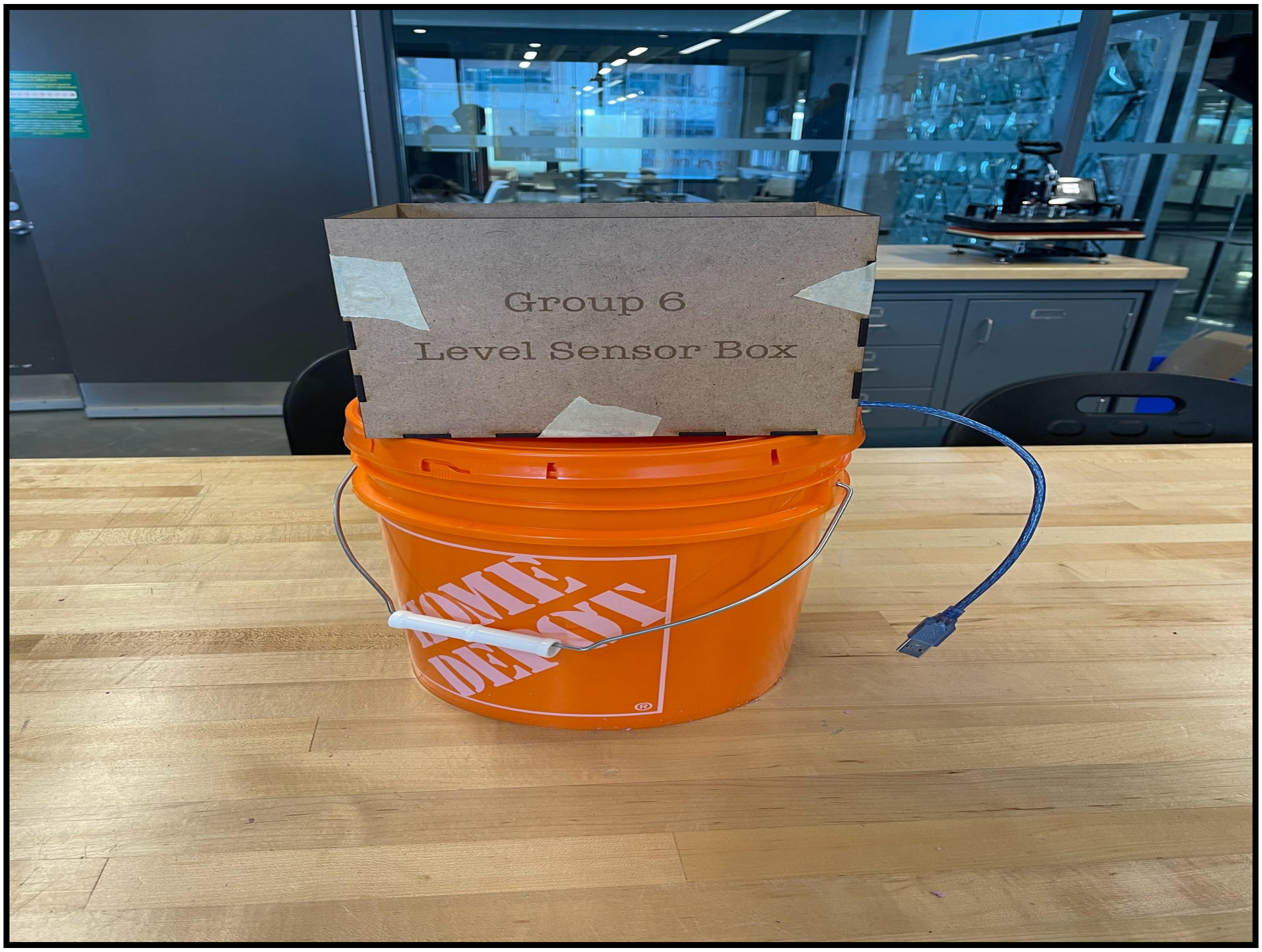
SKETCH

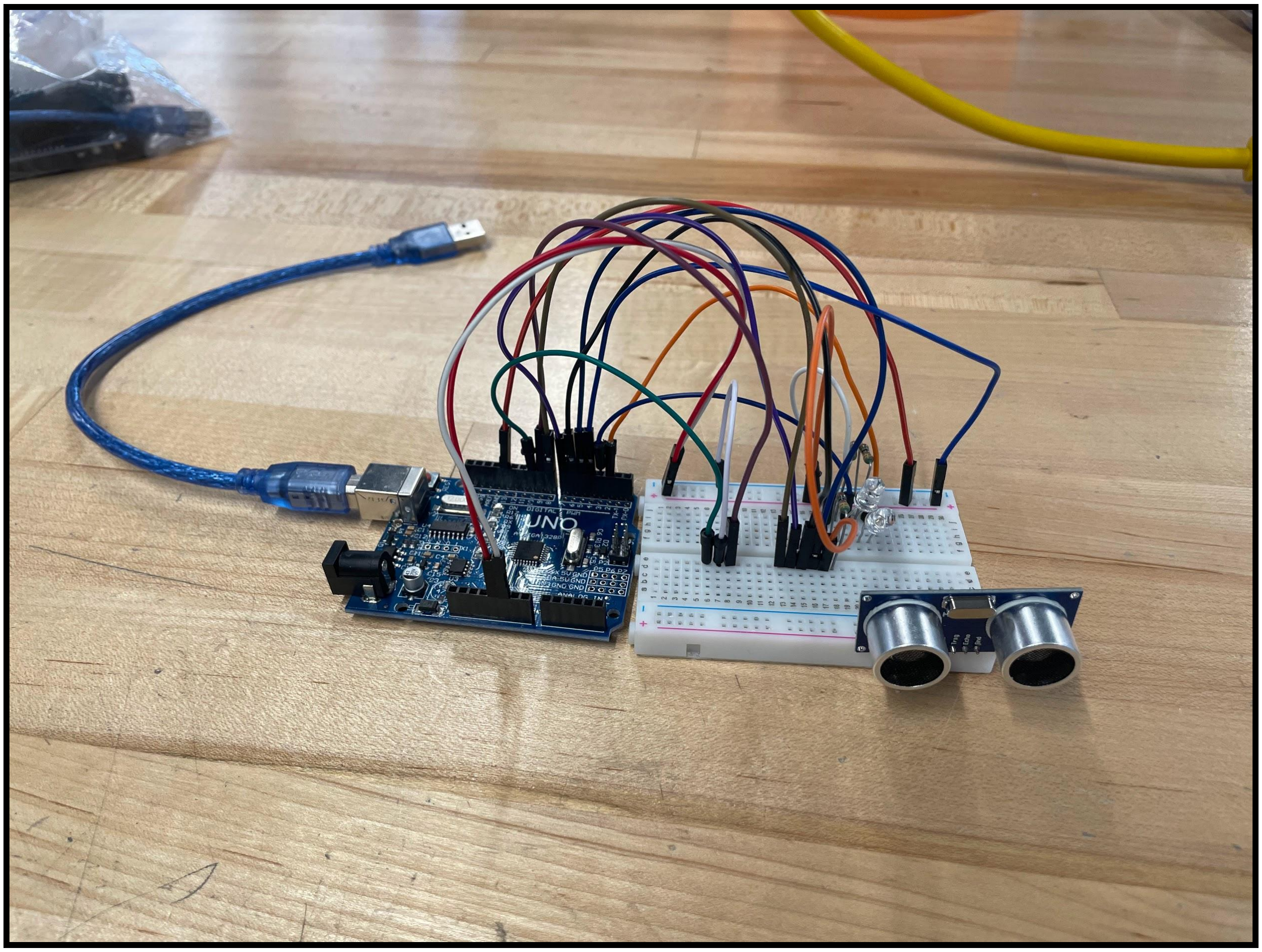

PROTOTYPE 1 SKETCH
Computer: with Arduino Code interface
Arduino
Breadboard & LCD Display Monitor
Ultrasonic sensor (HC-SR04 Model)
MDF box
Glue to attach MDF box to the Lid of the bucket
Lid
Bucket
MDF BOX DESIGN (Made with the laser cutter):
Hole for Arduino to Computer cable
6 inches
6 inches
8 inches
UNO
MDF BOX DIMENSIONS:
8 inch x 6 inch x 6 inch
AND
1/8 inch Thickness

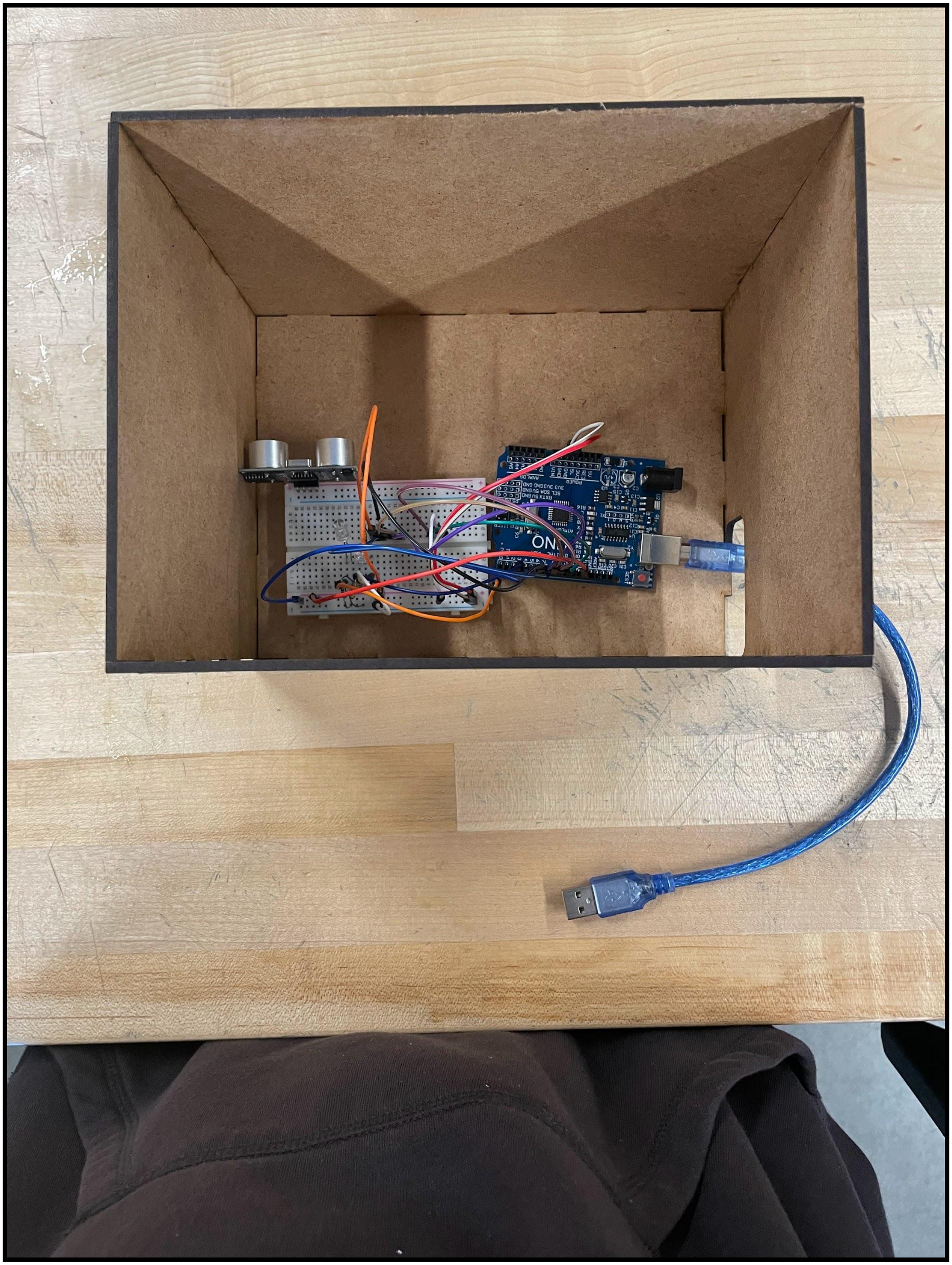
1. Pictures of our Prototype:






Group 6
Level Sensor Box
HOME DEPOT





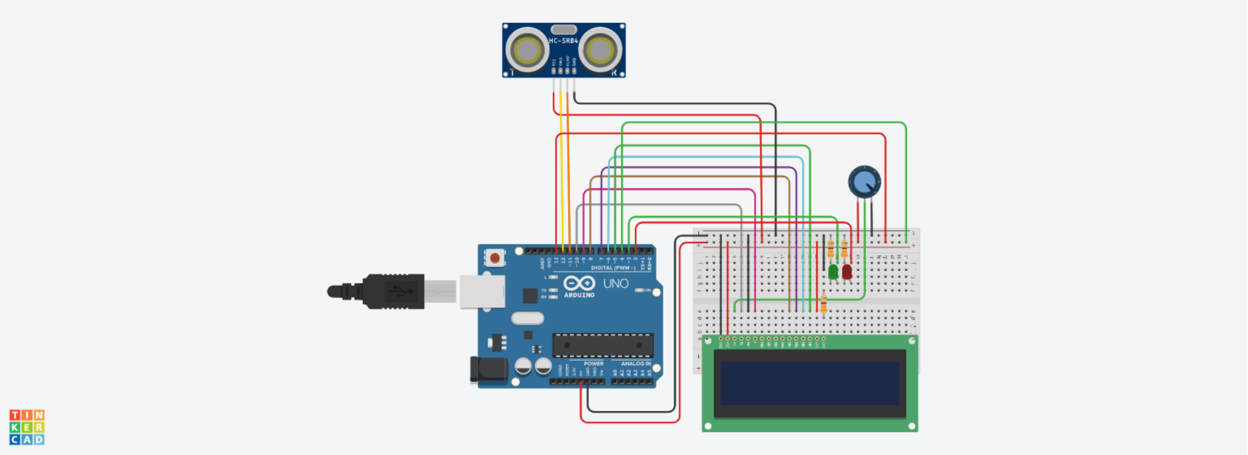
ANALYSIS OF THE SYSTEM

Due to materials not arriving on time, we could not complete testing so to make up for this we made an analytical model to simulate the real prototype. Using the analytical model, all tests can be answered but we understand that real world conditions can affect this, we will be able to perform testing for prototype 2 onwards though.

The purpose of this prototype is to create a system that can measure and display the level of the bucket or silo, this is done using the ultrasonic level sensor, LCD display monitor , and RGB LED lights. The Ultrasonic detects the level of the bucket below it and has a range of 2 cm to 400cm. This range works because the thickness of the MDF box and the bucket lid is not up to 2cm, so it is not in the range of the sensor, therefore not interfering with the level measurements.

As the sensor detects the level of the bucket, it is connected to an LCD display monitor, RGB LED Lights, and a potentiometer through the breadboard. The LCD Display Monitor shows the measurements in cm for the user to see, the potentiometer switches on the LCD display when turned to the right by stopping resistance to it. The Red LED light switches on when the level is below 5 cm showing that the bucket is almost empty, while the Green LED light switches on when the level is between 20 cm and 25 cm showing that the bucket is almost full.

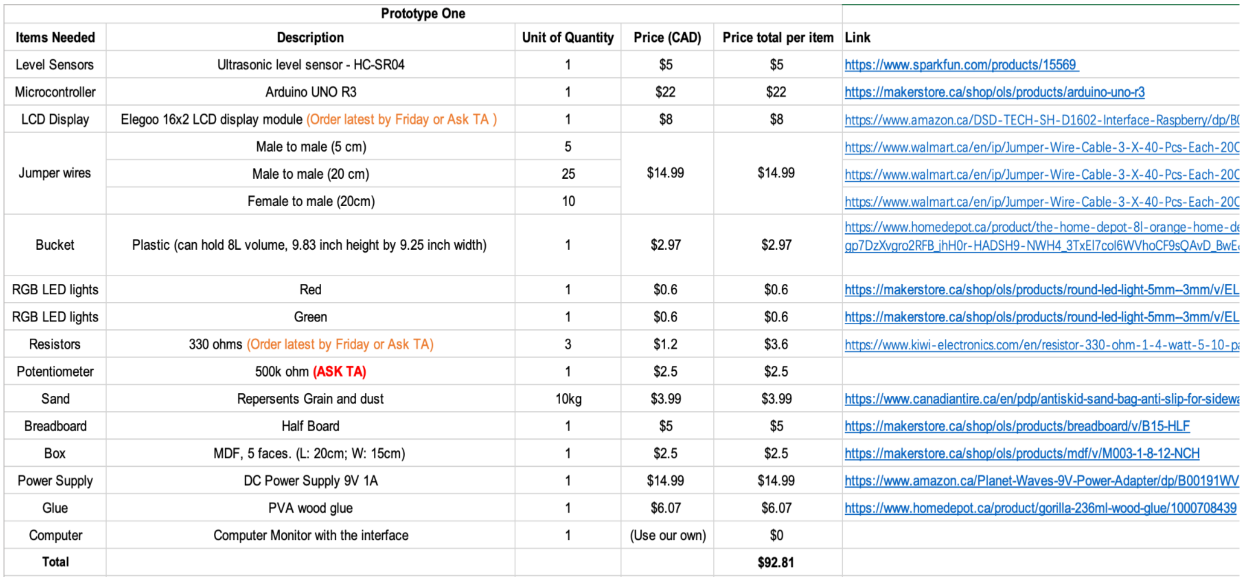
ANALYTICAL MODEL (RASPBERRY PI)



MATERIALS NEEDED FOR PHYSICAL PROTOTYPE

Box for the arduino, bread board and sensor (slit for sensor to work? NO). Box has a hole.
How to make holes for the tube and how to attach it (Only do the tubes part if we have time after everything else)? FOR PROTOTYPE 2
What are we using to represent the grain and dust? Sand for Prototype 1 only

2. Table of B.O.M (Bill of Materials)



Prototype One					
Items Needed	**Description**	**Unit of Quantity**	**Price (CAD)**	**Price total per item**	**Link**
Level Sensors	Ultrasonic level sensor - HC-SR04	1	$5	$5	https://www.sparkfun.com/products/15569
Microcontroller	Arduino UNO R3	1	$22	$22	https://makerstore.ca/shop/ols/products/arduino-uno-r3
LCD Display	Elegoo 16x2 LCD display module (Order latest by Friday or Ask TA)	1	$8	$8	https://www.amazon.ca/DSD-TECH-SH-D1602-Interface-Raspberry/dp/B
Jumper wires	Male to male (5 cm)	5	$14.99	$14.99	https://www.walmart.ca/en/ip/Jumper-Wire-Cable-3-X-40-Pcs-Each-20
	Male to male (20 cm)	25			https://www.walmart.ca/en/ip/Jumper-Wire-Cable-3-X-40-Pcs-Each-20
	Female to male (20cm)	10			https://www.walmart.ca/en/ip/Jumper-Wire-Cable-3-X-40-Pcs-Each-20
Bucket	Plastic (can hold 8L volume, 9.83 inch height by 9.25 inch width)	1	$2.97	$2.97	https://www.homedepot.ca/product/the-home-depot-8l-orange-home-d gp7DzXvgro2RFB_jhH0r-HADSH9-NWH4_3TxEl7col6WVhoCF9sQAvD_BwE
RGB LED lights	Red	1	$0.6	$0.6	https://makerstore.ca/shop/ols/products/round-led-light-5mm--3mm/v/EL
RGB LED lights	Green	1	$0.6	$0.6	https://makerstore.ca/shop/ols/products/round-led-light-5mm--3mm/v/EL
Resistors	330 ohms (Order latest by Friday or Ask TA)	3	$1.2	$3.6	https://www.kiwi-electronics.com/en/resistor-330-ohm-1-4-watt-5-10-p
Potentiometer	500k ohm **(ASK TA)**	1	$2.5	$2.5	
Sand	Repersents Grain and dust	10kg	$3.99	$3.99	https://www.canadiantire.ca/en/pdp/antiskid-sand-bag-anti-slip-for-sidewa
Breadboard	Half Board	1	$5	$5	https://makerstore.ca/shop/ols/products/breadboard/v/B15-HLF
Box	MDF, 5 faces. (L: 20cm; W: 15cm)	1	$2.5	$2.5	https://makerstore.ca/shop/ols/products/mdf/v/M003-1-8-12-NCH
Power Supply	DC Power Supply 9V 1A	1	$14.99	$14.99	https://www.amazon.ca/Planet-Waves-9V-Power-Adapter/dp/B00191WV
Glue	PVA wood glue	1	$6.07	$6.07	https://www.homedepot.ca/product/gorilla-236ml-wood-glue/1000708439
Computer	Computer Monitor with the interface	1	(Use our own)	$0	
Total				**$92.81**	

3. ANALYTICAL MODEL ASSUMPTION

1. Assuming that the barrel, drum or tank is less than 3m long and less than 3cm thick.
2. Assuming that we can connect a laptop to it with a wire, it has to be close to the prototype.
3. Assuming that the physical model works just as well as the analytical, considering that there are a large number of wires.
4. Assuming that there are no problems with the equipment.

4. Test Plan for Prototype 1 (Testing was done with Arduino kit 10(A) in Makerspace)

Most critical and risky aspects to test:

1. If the Ultrasonic sensor's range is large enough for the barrel and if the sensor readings accurately measure the level in the barrel.
2. How long will the sensor last
3. If the tubes can reliably pump and output sand or snow.
4. If the wires stay in place over time
5. Be sure that the barrel cover can hold the weight of the arduino, breadboard, LCD display monitor and the ultrasonic sensor securely in place.

Not important, but if we have time to test:

1. How to blow grain in and out of the barrel?

Test ID	***Test Objective*** ***(Why)***	***Description of Prototype used and of Basic Test Method*** ***(What)***	***Description of Results to be Recorded and how these results will be used (How)***	***Estimated Test duration and planned start date*** ***(When)***
1	To ensure that the readings are not wrong	Test it by knowing how much sand/snow is poured into the barrel per second, timing it, and cross checking it with the sensor reading.	Record the accuracy percentage in a table after at least 3 attempts	Start Test by Thursday March 2
2	To guarantee the life time of the sensor	Benchmark and research	Record the value	Start Researching on Wednesday March 1
3	To ensure errors to not come from the tubes or hoses having holes or not being attached to the barrel well	Check state of tube or hose before installation and after testing	Answer yes, if there are no issues with them, or no is errors occurred during testing	Start on Thursday March 2
4	To make sure the wires are secure to avoid any errors with the system	Use an Arduino with solder pads to solder wires into sockets,	Answer yes, if the wires stay secure throughout the	Start on Thursday March 2

			testing, but no, if they do not	

5. Client Meeting 2 Feedback:

- Make sure to stick with one idea which is the constant monitoring of the dust levels with the silo and will relay back to a monitor;
- Use dust sensors on top of the silo;
- Give feedback back to the computer (notifications) when the dust levels are getting high enough so we need constant monitoring;
- Constant feedback to the PCL;
- 3% of the grain is dust so if we know how much grain there is in the silo we can monitor the amount of dust before the build up happens this is what we need to focus on, not for the emergency to go off;
- To improve what we already had planned for us is the use of a MDF box to store the components that we need to run the dust sensors properly;
- We had to remove a lot of main ideas in order to only focus on one:
    - The sprinkler system;
    - The in-line sensor detector;
    - The density sensor;
-

Problems and solutions for prototype 1

- Problem: Won't be able to fully assemble the prototype by Sunday because some components ordered online delivers on Monday

Solution: Will be able to demonstrate a simulation of the arduino model on the computer, and assemble the box covering the where the arduino sits on top of the bucket.

- Problem: Won't have real life testing results until tuesday

Solution: will be able to test proper readings from the simulation

- Problem: out of the $300 dollar budget we have spent $119.12 that sets us back to $180.88 dollars of budget left for prototype 2 & 3.

Solution: Spend a maximum of $100 more dollars for prototype 2 & 3 and leave around $80 bucks to show the customers that the system has low expenses to make.