
Prototype III and Customer Feedback

Deliverable H

Client - Canadian Nuclear Laboratories

March, 23 2025

GNG1103-F

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Introduction:

This report contains documentation on the prototyping plan of the design, as well as updated prototypes and Bill of Materials. It has been split into the Project Task Plan, Prototyping plan, followed by the feedback received in the meeting with PM's, and ending in the updated plans and designs for each subsection of the machine.

Project Task Plan:

Task Description	Estimated Duration (Days)	Owner
Finish 3D printing some final parts	0.5	Fahad
Finish assembling prototype	0.5	Everyone
Finish testing prototype and tweaking the fine details	0.5	Everyone
Get feedback on final prototype	0.5	Everyone
Create final presentation and pitch and rehearse	1.5	Everyone
Create User manual and guide	2	Everyone

List Of Equipment Needed:

- 3D printer
- Onshape
- Soldering station
- Cirkuit designer
- Hand Tools

Prototyping and Test Plans:

Test Number	Probable Critical Issue	Test Objective (why)	Test description (what)	Stop Criterion
1	Robot can move down the tube and safely come back (horizontal sampling)	Testing for performance, Distance Travelled In how much time (feet/sec)	Do test runs. Observe if the RPM is being correctly changed and if the motor can handle it	Robot manages to move down the tube and come back
2	Controlled Drilling Mechanism	Performance, Management, Distance drilled (inches)	Drill into a material and test to see if device can make holes the same size consistently	Drilled hole sizes are consistent within the past 3 attempts
3	Collection Mechanism	Performance, Management, Amount of material collected (mg)	Drill a consistent hole into a material that will turn into powder, and measure how much the collection system collected in mg	The collected amount is consistent within 7 mg in the past 3 attempts
4	Test durability of ethernet cable (doubles down as Fail Safe Mechanism)	Risk Management	Lower the robot 15 feet down the tube with a pulley and retrieve it	Ethernet cable handles comfortably the weight of the robot and is durable.
5	Testing piezoelectric sensor to see if it works correctly and is not defective	Performance	Apply weights and see if the voltage returned is correct	Voltage difference is consistent across weights (identical weight returning same value, etc.)
6	Feedback system test	Management, Risk management	Run through a material extraction process simulation	There is clear feedback for when the prototype reaches 15 feet, finishes drilling and comes back

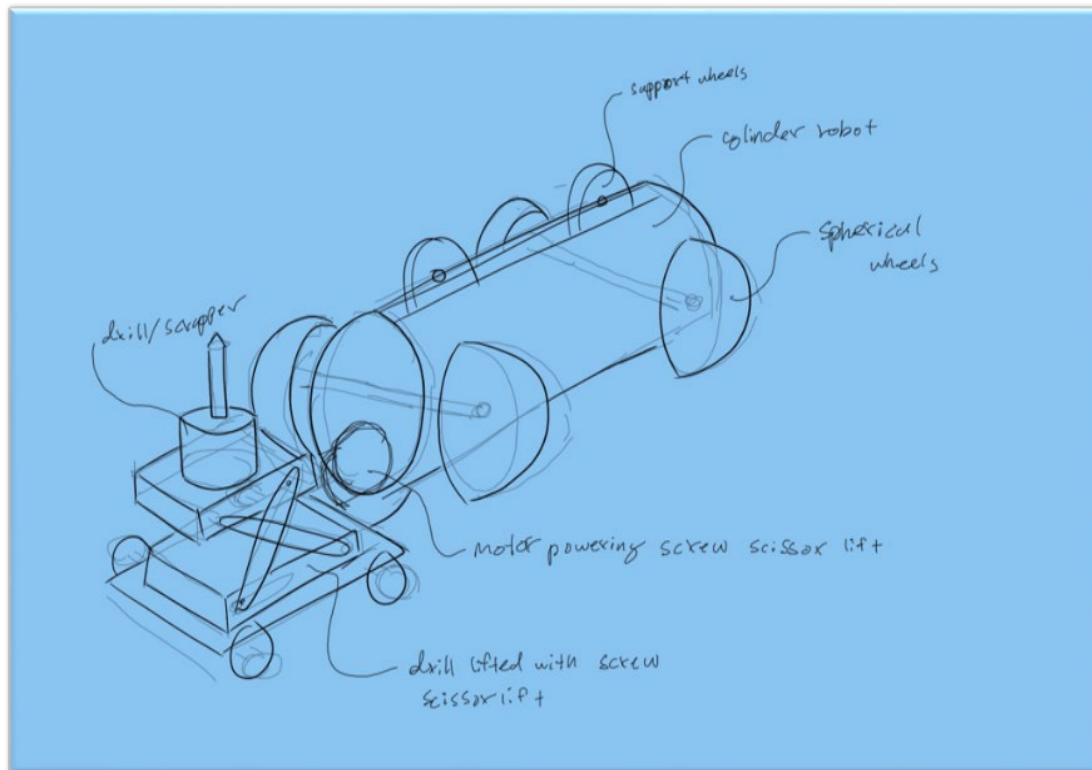
Project Risks:

<u>Risks</u>	<u>Contingency plan</u>
Prototype failing severely	<ul style="list-style-type: none">- Change Implementation of the section- Or in extreme cases redesign the section entirely- Update Project Task Plan and timetable to account for added prototyping
Team Members not contributing	<ul style="list-style-type: none">- Have a team reflection regarding the unfinished task- Align expectations with the group- Potentially meet with PM or TA- Provide support for teammate- Update Project Task Plan and timetable

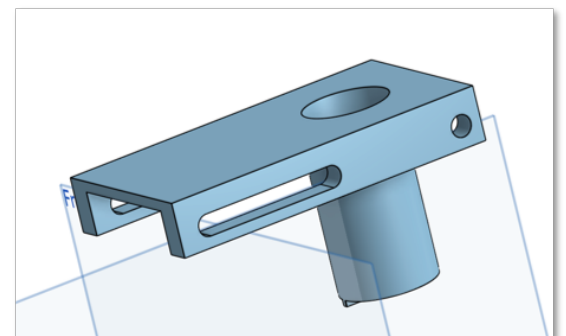
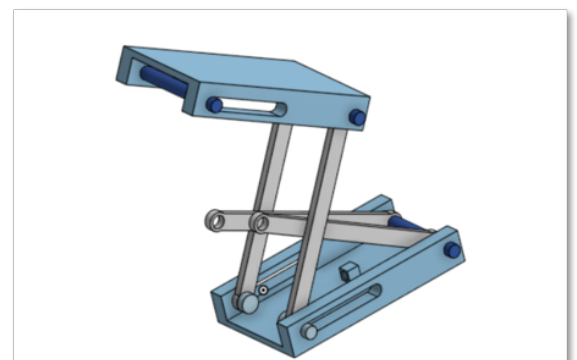
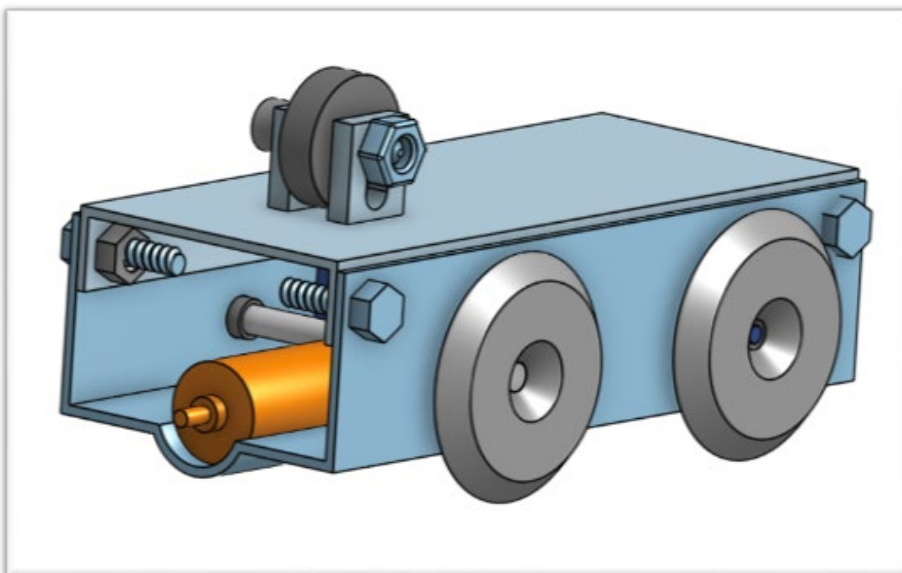
BOM excel sheet:

BOM - group 15

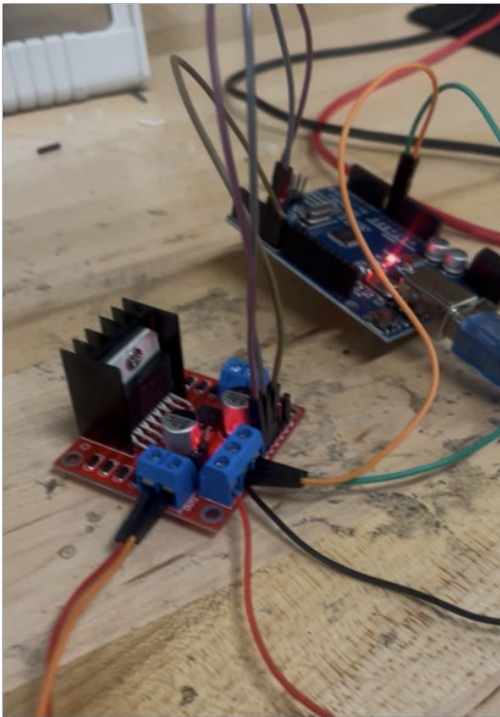
Prototype Sketch:



Design CAD:



Arduino Circuits:



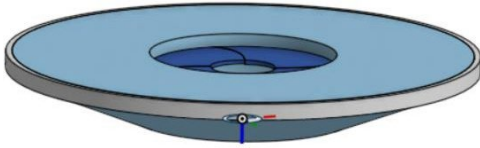
```
void loop() {  
  if (Serial.available()) {  
    command = Serial.read(); // Read user input  
  
    // If the input is a number, set speed  
    if (command >= '0' && command <= '9') {  
      motorSpeed = Serial.parseInt(); // Convert input to an integer  
      if (motorSpeed >= 0 && motorSpeed <= 255) {  
        analogWrite(ENA, motorSpeed);  
        Serial.print("Speed set to: ");  
        Serial.println(motorSpeed);  
      }  
    }  
  
    // If the input is a character, set direction  
    else if (command == 'F' || command == 'f') {  
      digitalWrite(IN1, HIGH);  
      digitalWrite(IN2, LOW);  
      Serial.println("Motor moving Forward");  
    }  
    else if (command == 'B' || command == 'b') {  
      digitalWrite(IN1, LOW);  
      digitalWrite(IN2, HIGH);  
      Serial.println("Motor moving Backward");  
    }  
    else if (command == 'S' || command == 's') {  
      digitalWrite(IN1, LOW);  
      digitalWrite(IN2, LOW);  
      Serial.println("Motor Stopped");  
    }  
  }  
}
```

AI Generated

- Purpose:
 - o This circuit controls all 4 of our motors. 2 of them control the wheels while one is used for scrapping and the other to power the lift.
- Materials:
 - o DC drivers
 - o Wires
 - o Arduino
 - o Motors
- Results/Feedback:
 - o The circuit was able to properly power all 4 of our motors

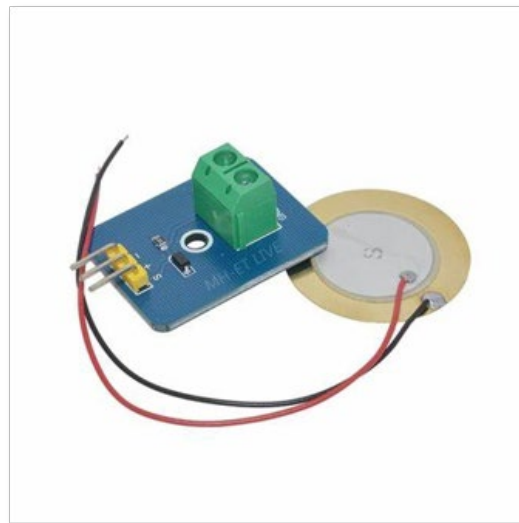
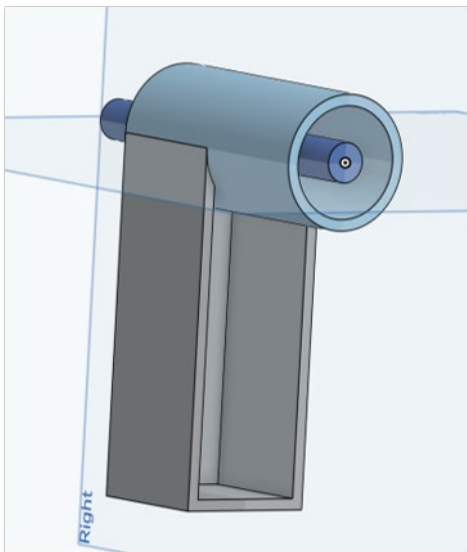
Collection System:

Collection system for horizontal use:



- Explanation: A fully 3D printed container that attaches atop the motor and below the drill. It is constantly closed due to the lid being sloped inwards, and utilizes the centrifugal force generated by the spinning of the motor to open.

Collection system for vertical use:



- Explanation:

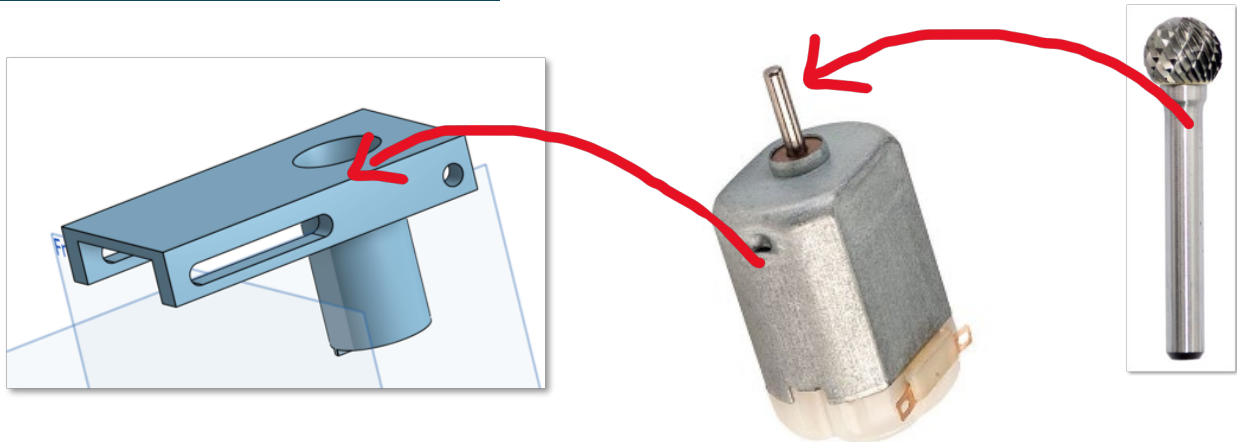
A fully 3D printed container that gets pushed to the side of the tube and stores the sample. A piezoelectric sensor is placed at the bottom of the container so that we get real-time measurement of how much sample we've drilled.

Basic Prototype for horizontal collection system:



- Purpose:
 - To test the closing system utilizing the centripetal force of the collection system
- Materials:
 - PLA
 - Paper
 - Pencil
- Results/Feedback:
 - The opening mechanism worked decently well and would propagate open once the collector was spun.
 - The closing mechanism once the collector stopped spinning, was not consistently working, and got the lid pieces stuck inside of the contraption (leading to the paper substitution).

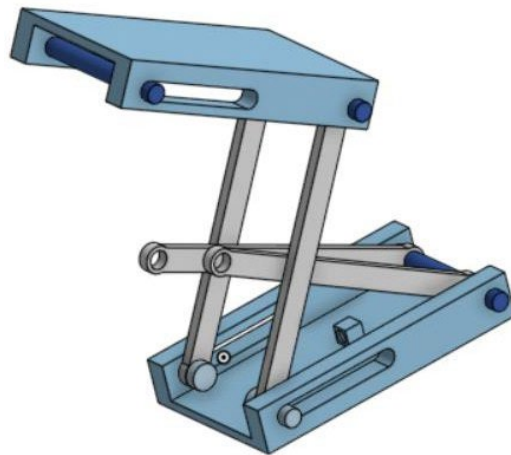
Drill and motor component:



Explanation:

This Cad design represents the drill component that supports our motor and the drill bit at its tip. This component is the top part of our scissor lift which makes it possible to lift the drill bit to the tube's ceiling for sampling without scraping the whole tube.

Motor Lifting Design:



Explanation: this design takes inspiration of a screw scissor lift, unfortunately from the picture it does not look like a screw scissor lift due to trouble of assembling parts in CAD.

Besides that, this screw scissor lift consists of two platform, one on the bottom and one on the top that are lifted by two arms. The platform will be lifted upwards using a bolt and a nut that will spin. The spin will be powered by a motor. When the motor is turned on the arms will slide down along with the pins to lift the platform upwards.

User Feedback Received:

- Easy to use
- Not heavy
- Compact design
- The wheels' motors are a bit noisy
- Lack of feedback system (hasn't been implemented yet)

Engineering Analysis:

- Physical low fidelity prototype tests have been done on the expanding and collection system as stated throughout the report
- Tests have been going smoothly for now:
 - o Circuit works properly
 - o Robot can properly move
 - o Lift works as intended