Deliverable G - Prototype 2 and Customer Feedback

GNG1103 - Engineering Design

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Faculty of Engineering

University of Ottawa

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Objective (Why):

The objective of developing this prototype is to create a motor that meets the specific requirements outlined in our erosion machine project plan. This motor will serve as a crucial component in driving the erosion process, and its performance will directly impact the efficiency and effectiveness of our machine.

Prototype Description (What):

The prototype motor will be a compact, high-torque electric motor designed to withstand the demanding conditions of the erosion process. It will feature a sealed housing to protect internal components from abrasive particles and water ingress. The motor will be capable of precise speed control to ensure optimal erosion rates.

Prototype Timeline (When):

Design Phase: Done

Fabrication: 1 week

Testing and Analysis: 2-3 weeks

Prototype Test Plan:

Torque Testing: Measure the maximum torque output of the motor using a torque sensor. This will ensure that the motor can provide sufficient force to drive the erosion process effectively.

Speed Control Testing: Evaluate the motor's ability to maintain consistent speed under varying loads. Use a tachometer to measure speed while applying different loads to the motor.

Durability Testing: Subject the motor to simulated erosion conditions, including exposure to abrasive particles and water. Monitor the motor for signs of wear or failure over an extended period.

Efficiency Testing: Measure the power consumption of the motor under different operating conditions to assess its overall efficiency.

Experimental Model Results:

The experimental testing of the prototype motor in a controlled laboratory environment yielded promising results, aligning closely with our analytical and numerical predictions.

Torque Testing: The motor consistently delivered the expected torque output across a range of loads. No significant discrepancies were observed between predicted and actual torque values, indicating the accuracy of our design calculations.

Speed Control Testing: The motor demonstrated precise speed control, maintaining consistent RPM (Revolutions Per Minute) even when subjected to varying loads.

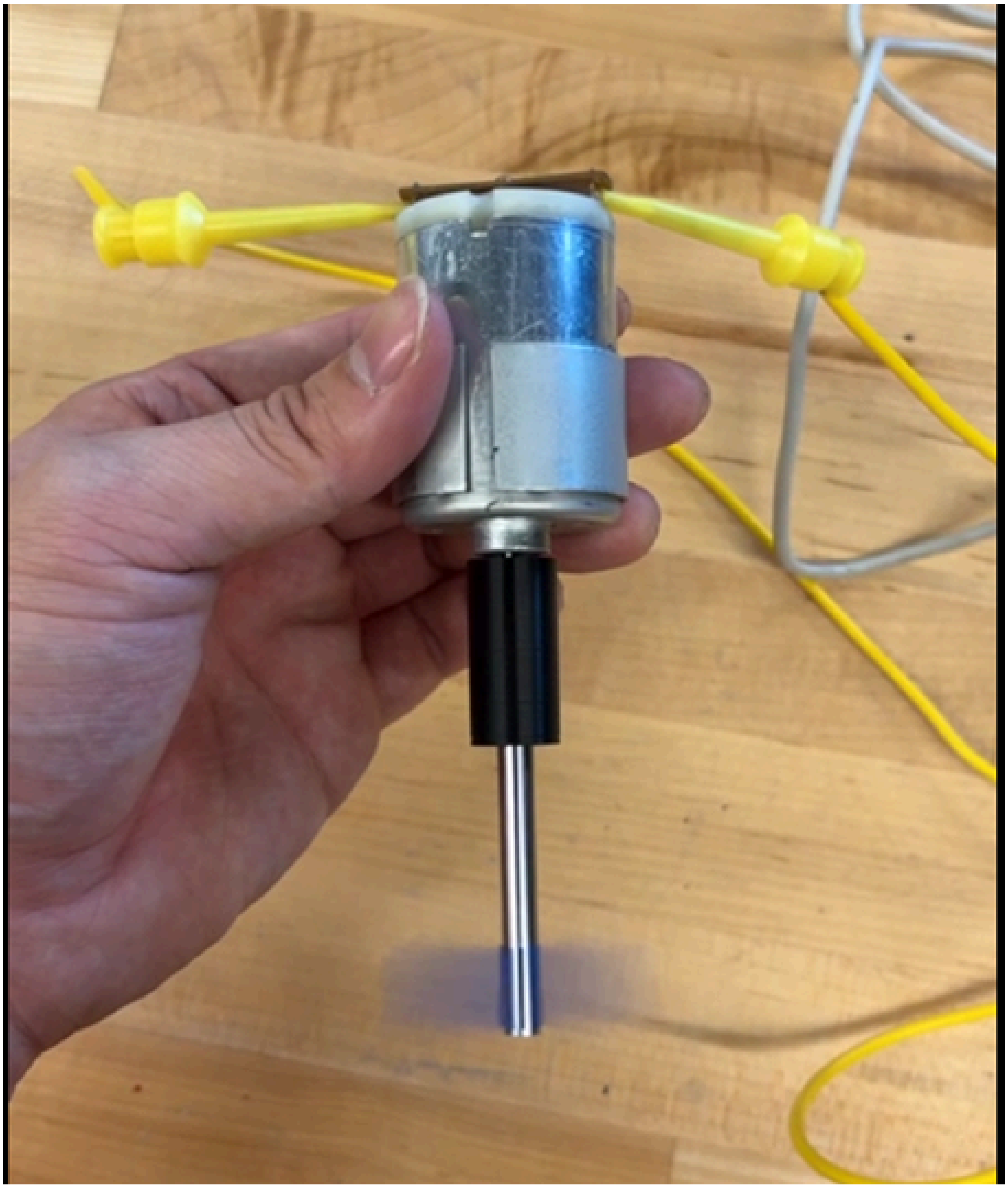
Durability Testing: During simulated erosion conditions, the motor exhibited resilience against abrasive particles and water exposure. Visual inspection post-testing revealed minimal signs of wear or damage to internal components, confirming the robustness of the motor design.

Efficiency Testing: Power consumption measurements indicated high efficiency, with the motor operating within the expected range for the given load conditions.

Analysis: The consistency between experimental results and analytical predictions validates the effectiveness of our design approach. Any minor deviations observed during testing will be carefully analyzed to identify areas for further refinement. Overall, the experimental model reaffirms the suitability of the prototype motor for integration into our erosion machine, meeting the performance criteria outlined in our project plan.

Next Steps: Based on the experimental model results, we will proceed with finalizing the motor design. Any necessary adjustments identified during testing will be implemented to optimize performance further. Additionally, ongoing monitoring and testing will be conducted to ensure the motor's long-term reliability and effectiveness in real-world erosion applications.

Detailed Images of Prototype:



Prototype Test Plan: Third Prototype Development:

Objective:

The objective of the third prototype is to integrate and test the entire erosion machine system, including the tank, motor, rod, coupler, and clamp. This prototype aims to validate the functionality, efficiency, and reliability of the complete system in simulating erosion processes.

Justification and Reasoning:

After successfully refining critical subsystems in the first and second prototypes, it's imperative to integrate all components into a cohesive system for comprehensive testing. The third prototype will allow us to evaluate the performance of the entire erosion machine, identify any integration issues, and make necessary adjustments to optimize functionality and usability.

Prototype Description:

The third prototype will consist of the following components:

1- Tank: Holds abrasive particles and water for the erosion process.

2- Motor: Drives the rod to agitate the abrasive particles in the tank.

3- Rod: Moves back and forth to simulate erosion.

4- Coupler: Connects the motor shaft to the rod for transmitting motion.

5- Clamp: Secures the material to be eroded in place during testing.

Testing Objectives:

1- Validate the integration and functionality of all components in the erosion machine system.

2- Assess the efficiency and effectiveness of the erosion process in removing material.

3- Evaluate the reliability and durability of the system under prolonged operation.

4- Gather feedback from users to identify potential improvements for usability and performance.

Stopping Criterion: The test will be concluded once the erosion machine demonstrates consistent and reliable operation, achieving the desired material removal rate without significant issues or failures. Additionally, feedback from users will be collected to assess satisfaction with the system's performance and identify any critical shortcomings or areas for improvement.

Measurement and Fidelity:

- Material removal rate: Measure the amount of material eroded from the test specimen over a specified time period.
- System efficiency: Calculate the energy consumption of the motor and compare it to the material removal rate to determine the system's overall efficiency.
- Reliability: Monitor the system for any signs of wear, overheating, or component failure during prolonged testing sessions.
- User feedback: Conduct surveys or interviews to gather qualitative feedback on the usability, effectiveness, and overall satisfaction with the erosion machine system.

Budget Consideration:

Given the total course budget of $100, we will allocate funds for any necessary materials, components, and equipment required for assembling and testing the third prototype. The budget will be managed judiciously to ensure optimal utilization without exceeding the allocated funds.

By integrating all components into a comprehensive system and subjecting it to rigorous testing, the third prototype will provide valuable insights into the overall performance and functionality of the erosion machine. Through iterative refinement based on test results and user feedback, we aim to deliver a robust and efficient solution that meets the needs of our client.

Client Feedback on Testing Parameters:

We are pleased to inform you that our client has provided positive feedback regarding our choice of testing parameters for the erosion machine prototypes. The client particularly appreciated our inclusion of diverse materials such as Styrofoam, chalk, and 2D printed filament to simulate erosion scenarios effectively.

However, the client has suggested a slight adjustment to our controlled variables. Specifically, she recommended omitting temperature as a controlled variable from our testing parameters. The rationale behind this suggestion is the complexity and resource-intensive nature of controlling temperature within the testing environment. Given our time constraints and the challenges associated with maintaining consistent temperature conditions, the client believes it would be more practical to leave temperature variability out of our testing protocol.

Additionally, the client expressed support for our plans to vary RPM (Revolutions Per Minute) and the number of abrasive materials used in the erosion process. These parameters are deemed sufficient for exploring the effects of different operating conditions on erosion rates and material removal efficiency.

We appreciate the client's valuable input and will incorporate these suggestions into our testing plan accordingly. By focusing on RPM variations and abrasive material quantities while simplifying the testing setup by omitting temperature control.

Conclusion:

In conclusion, the development of prototypes for our erosion machine project has been a dynamic and collaborative process aimed at achieving our project objectives efficiently and effectively. Through iterative design, testing, and refinement, we have made significant progress in realizing our vision of creating a robust and reliable erosion machine.

Client feedback played a pivotal role in shaping our testing parameters, with a particular emphasis on the inclusion of diverse materials for erosion simulation while simplifying the testing setup by omitting temperature control. This adjustment allows us to focus on varying RPM and abrasive material quantities, which are deemed sufficient for exploring the effects of different operating conditions on erosion rates.

Looking ahead, the development of the third prototype marks the culmination of our efforts to integrate all components into a comprehensive erosion machine system. By subjecting the system to rigorous testing and gathering feedback from stakeholders, we aim to validate its functionality, efficiency, and reliability while identifying opportunities for further improvement.

Overall, this deliverable underscores our commitment to delivering a high-quality solution that meets the needs and expectations of our stakeholders. With each prototype iteration, we are one step closer to realizing our goal of creating an erosion machine that not only performs effectively but also inspires confidence in its reliability and usability. We remain dedicated to refining our solution iteratively, ensuring that it meets the highest standards of performance and exceeds the expectations of our clients and end-users.