The Application of a Single Actuation Multiple Manipulation (SAMM) Mechanism for Energy Preservation

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INTRODUCTION

- To achieve multiple degrees of freedom (MDOF) with one actuator in order to minimize the size and need for multiple motors in a multitude of products our mechanism has selective modules to perform separate actuation.
- The SAMM mechanism will use rotating gears and oscillating ratchets.
- The single motor in the SAMM design will have its motion distributed throughout the surrounding modules through their respective output shafts.
- In turn, energy used to manufacture multiple actuators per DOF will decrease.
- It can also lower initial monetary investment, total actuator weight, and need for maintenance.

MATERIALS & METHODS

- The design of the SAMM model will be tested with a 3D printed housing as shown along with printed doors and ratchets to be sure of the viability.
- The assembly will be arranged with worms, gears, ratchets, a motor and a Lego excavator for proof of concept.
- The SAMM mechanism will be attached to the excavator by its output shafts to turn the excavators gears for its arm and claw to move in different directions.

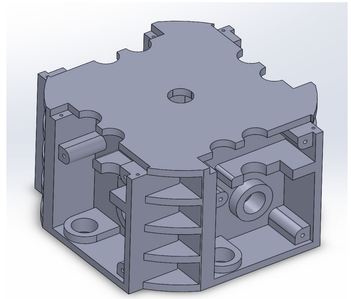

Figure 1. Stripped down SAMM design with housing shown as a solid piece for easier assembly.

EXPERIMENTAL SETUP

- The actuation of the centralized motor of our design is realized through a ratchet system.
- The design concept is displayed here. It shows how the motor, along with the fixed hinge will pass through the ratchets that then transfer through the gear trains to each output shaft per module for each DOF.

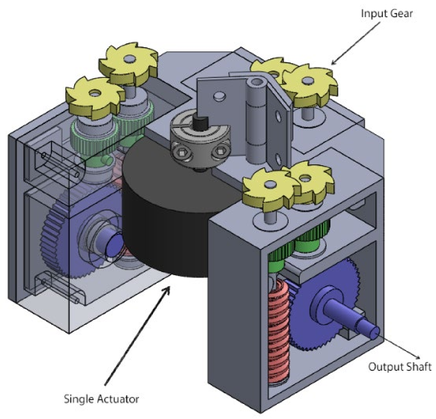

Figure 2. SolidWorks prototype design with one side uncovered to show assembly.

- The motor for this mechanism is stepper motor Nema 16 in order to achieve the correct amount of torque.
- A SAMM mechanism is optimum for systems with many DOFs that require slow movement and holding of a stand still position. Prime examples of this class include CCTV cameras and telescopes.

DESIGNS

Ratchet

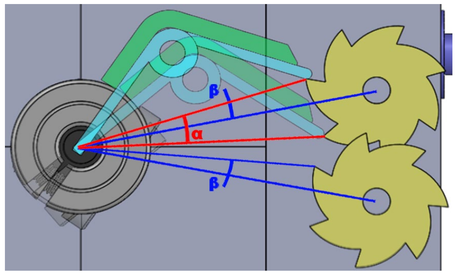

Figure 3. Top view of angle of rotation for each tooth of the input ratchet system. This produces 1.29 degrees of rotation in the output shaft. (α = 14.93 degrees, β = dephase angle

Module

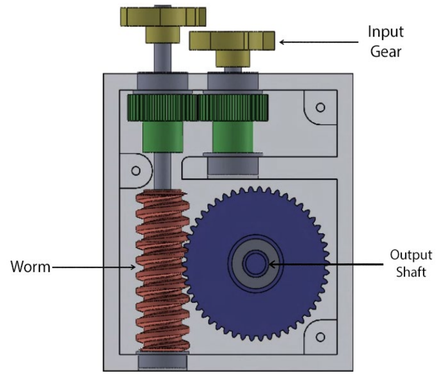

Figure 4. Front view of gears for the conversion of the rotation of the motor to output gear.

EXPECTED RESULTS & CONCLUSION

- The capabilities of the current design allow for an output ratio of the gear train is 40:1. Using the seven teeth ratchet configuration after 280 oscillations the mechanism's output shaft will complete one rotation. The mechanism will be placed on a modified Lego excavator to demonstrate how it can achieve MDOF. The SAMM mechanism has an inherent scalable body for the addition of more DOFs.

Figure 5. Modified Lego excavator for SAMM to be connected to for demonstration of MDOF with arm and claw movement.

- The energy challenges facing humanity continue to grow with an increasing demand and production of products in surplus so to eliminate wasteful energy habits from the source by reducing the manufacturing of motors with this design can pose a great impact. For example, in telescopes, health facility beds, hospital equipment, surgical robots, and CCTV cameras.

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