Implementation of the Single Actuator Multiple Manipulation (SAMM)

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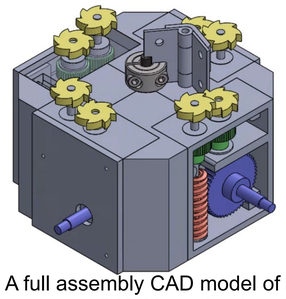
OBJECTIVE

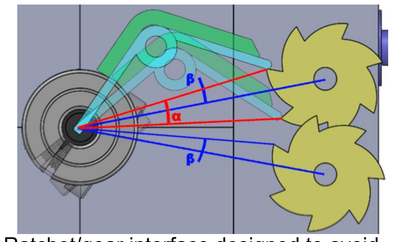
The purpose of this research is to reduce the number of actuators needed per degree of freedom (DOF) to perform a 3D Motion to one actuator that can carry out multiple degrees of freedom (MDOF)

INTRODUCTION

- Single Actuator Multiple Manipulation (SAMM) mechanism makes it possible to centralize the control of an entire multiple degrees of freedom (MDOF) system to a single actuator
- SAMM can be created by designing individual modules to transfer the bi-directional rotation of an actuator to each degree of freedom (DOF).
- The simplicity of a SAMM mechanism's selective activation of modules allows it to adequately mimic MDOF motion through the use of only gear trains and an oscillation ratchet mechanism
- As the number of DOFs increases, a SAMM mechanism can also significantly reduce the total actuator weight of a system
- In order to prove the viability of the SAMM concept, it is necessary to design a working prototype to transfer the motion of a single motor to multiple output shafts
- Energy used to manufacture multiple actuators per DOF will decrease.



A full assembly CAD model of the prototype SAMM mechanism. This prototype presented provides a scalable design that can be easily adapted to accommodate extra DOF manipulation modules



Ratchet/gear interface designed to avoid interference. "a" is the contact angle between the ratcheted and the input gear This 14.93 ° rotation in the motor shaft produces approximately 1.29V of rotation in the output shaft. The angle "b" is an offset angle with respect to a radial line from the motor shaft to the center of the input gears

MATERIALS

- Stepper Motor (NEMA 17) – Achieves precise positioning and/or speed control for motion controlled applications
- A4988 Stepper Driver – Controls bipolar stepper motors
- Arduino Board – Reads input and turns it into an output
- Breadboard and Jumper Wires – makes the process of changing a circuit easy

PROCEDURE

- Using the prototype configuration, motor must rapidly turn on and off in a controlled and accurate manner
- Using Arduino, we will control a Stepper motor using the A4988 Stepper Driver (used to control bipolar stepper motors which has built-in translator for easy operation)
- The driver provides five different step resolutions: full-step, haft-step, quarter-step, eight-step, and sixteenth-step
- Driver will hook up to the stepper motor and micro-controller
- Pins used to power the motor power supply, which will then be connected to the stepper motor

EXPECTED RESULTS

- With SAMM, we will be able to reduce the number of actuators needed per DOF to perform a 3D motion to one actuator that can carry out MDOF.
- As a result of this, SAMM will cut down the number of motors companies manufacture for their products. Subsequently, this would greatly reduce the environmental impact and cost to produce their products.
- Some manufactured products that would benefit from SAMM would be: Hospital beds, CCTV cameras, and mechanized car seats

CONCLUSION

- CAD model is a viable design for a SAMM mechanism
- The prototype presented can be easily adapted to accommodate extra DOF manipulation modules
- Specific geometric conditions must be present to achieve an effective power transmission from the motor to the input shaft

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