Robot Arm End Effector

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ENGRMAE 189 - Senior Project

Sponsor: Archytas Automation

1-Introduction:

Archytas Automation's gripper end effector plays a crucial role in gripping and manipulating objects of diverse shapes, sizes, and weights. However, the existing gripper design faces several challenges, including motor housing and wiring issues, limitations imposed by its single-acting nature, and complexities during assembly. This project aims to address these concerns and enhance the grasp function.

2-Objective:

The project aims to redesign the gripper end effector for easy assembly, ensure structural integrity to accommodate new motor models, and enhance the grasp function for improved object manipulation.

3-Calculations and Analysis Approach:

The gripper mechanism underwent a thorough analysis, including dynamic assessment, gear dimension determination, force calculations, and comprehensive force analysis, to ensure its strength and reliability in fulfilling its intended functions, considering critical forces and moments.

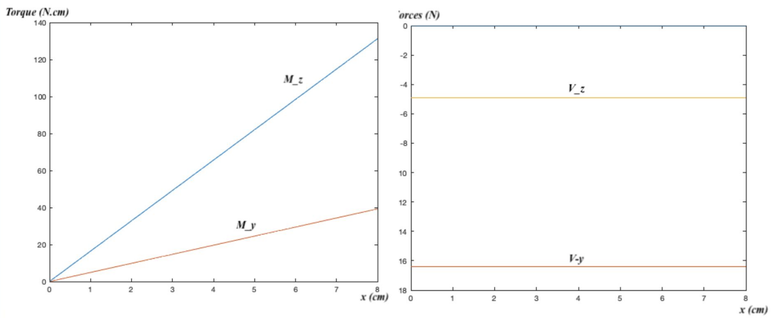

Figure 1: Forces and moments diagrams along the gripper mechanism

The gripper mechanism successfully passed the strength test by supporting a maximum weight of 3.5 kg.

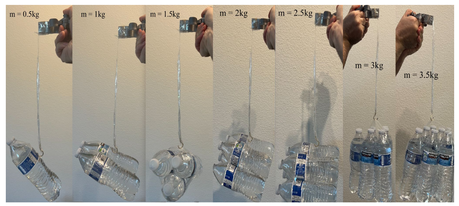

Figure 2: Strength test

4-Material and Methods:

The end effector, manufactured using Markforged printers, comprises a gripper mechanism, motor housing, and base mount. Reinforced with carbon fiber-infused Onyx filament, it ensures durability. It enables precise control with two Dynamixel motors, Molex six-pin connectors, and assembly using 8 mm M3 screws and square M3 nuts. It secures electrical connections, making it ideal for solid object manipulation in robotics.

5-Results:

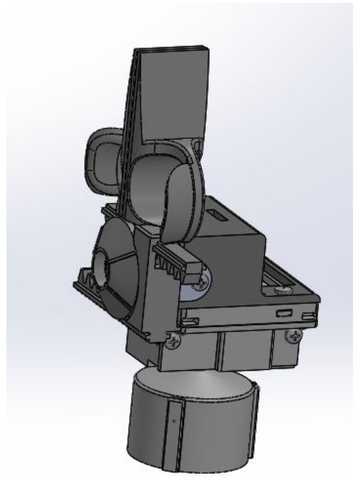

Figure 3: Isometric View of End Effector

Figure 4: Physical Model Attached to Arm

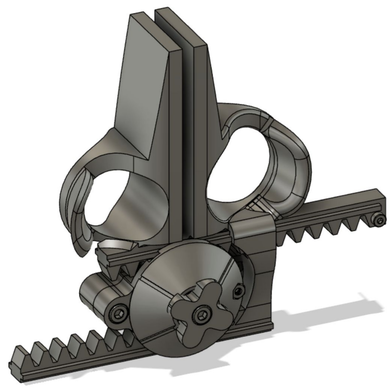

Figure 5: Isometric View of Gripper Mechanism

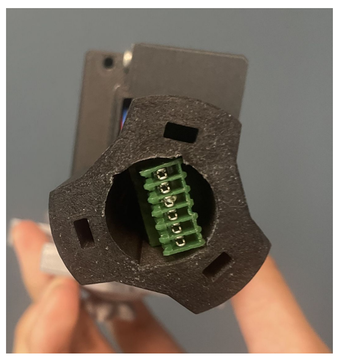

Figure 6: Bottom View of Base Mount

6-Conclusion:

Our team successfully redesigned Archytas Automation's end effector by improving Archytas' previous design, addressing challenges, and enhancing its grasp function. Thorough analysis and testing ensured the end effector's structural integrity for a maximum weight of 3.5 kg. This redesigned end effector holds the potential to improve object manipulation in the robotics and rehabilitation industries significantly. In future research, additional research should focus on understanding the capabilities of the 330 Dynamixel motors, exploring alternative modes of actuation and motor orientation for compactness and reliability, and considering implementing advanced materials and motor models.

7-References:

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