A Cable-Based Manipulator for Chemistry Labs

Introduction

The unusual grasping mechanism grants this manipulator two key features:

- **universal grasping** of cylindrical and prismatic objects.
- Grasping object in with **little clearance** required.

This allows for manipulation of most vessel found in chemistry labs

Fig. 1 – Different types of test tubes commonly found in chemistry labs

It is meant to provide a **flexible** tool that will make it easier to set up robotic systems to run chemistry experiments.

The design is **inexpensive** and can be easily integrated with commercially available robotic arms

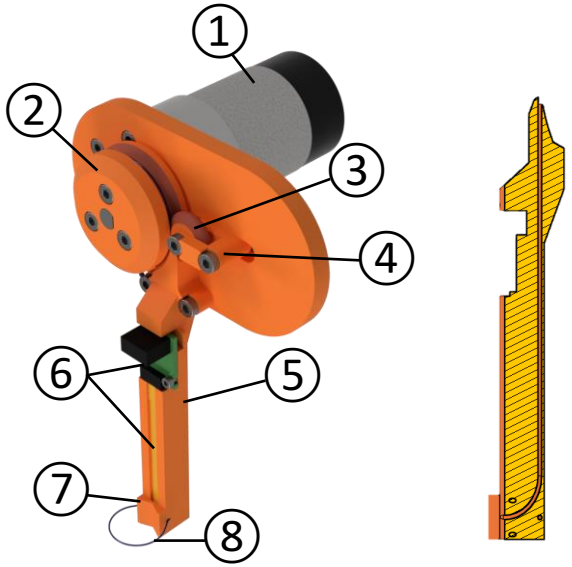

Fig. 2 – Render of the manipulator and section of the finger showing the internal channel.

Design

1. DC motor and encoder
2. Drive wheel to push and pull the cable
3. Idler
4. Idler tensioner
5. Finger with internal channels for the cable
6. Force sensor
7. Contact face for object indexing
8. Cable loop used for grasping

The system uses two independent **PI** closed loop controllers for force and position control.

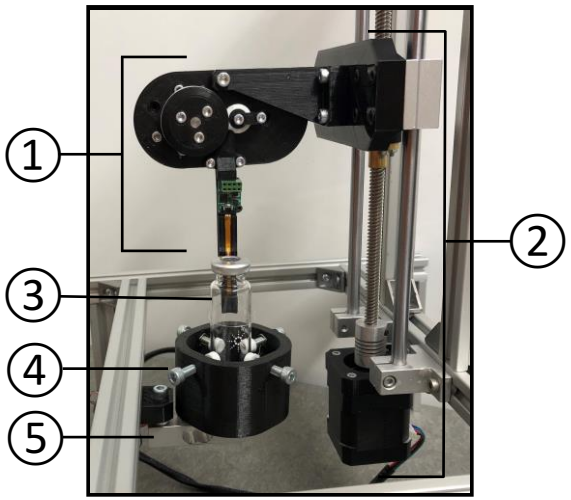

Fig. 3 – Manipulator mounted in the testing apparatus

Testing

1. Prototype manipulator
2. Linear actuator
3. Test sample
4. Test sample Clamp for test sample
5. Load cell

Sample of different diameters
(10mm < x < 40mm)
and different materials
(glass and PLA plastic)

each sample has bee tested 5 times for maximum lifting force before slip occurs

Results

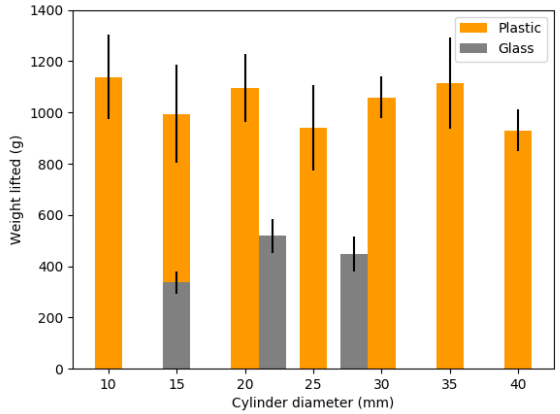

Fig. 4 – Test results

The manipulator can grip and lift object of increasing diameters without clear degradation in performance.

All this is achieved while keeping small footprint of the grasping appendix.

Conclusions

The design shows promise and improved prototypes using better material are currently in the under development.

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