

# Impedance Control Cable- Driven Gripper

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Meet Nandu

# Purpose

- Robotic applications increasingly trend towards closer interaction with humans, thus there is a desire for implementing high force, impedance-controllable end-effectors using cable transmission
- Worth exploring nuances of robotic impedance control for cable-driven systems



## AMBIDEX

### Unique Cable-Driven Mechanisms

사람의 팔과 같은 7개의 자유도  
모든 관절에서 강도와 힘을 높이는 혁신적 메커니즘

### Light but Strong

사람 팔보다 가볍고 유연한 관절  
빠르고 정밀하게 동작하면서도 안전

무게: 2.63 kg

한 팔 구동 퍼프 기준. 몸체 포함시 6.8 kg

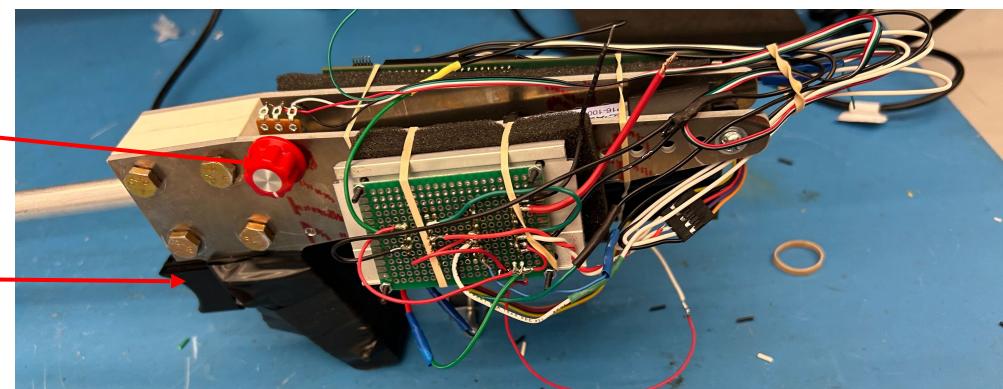
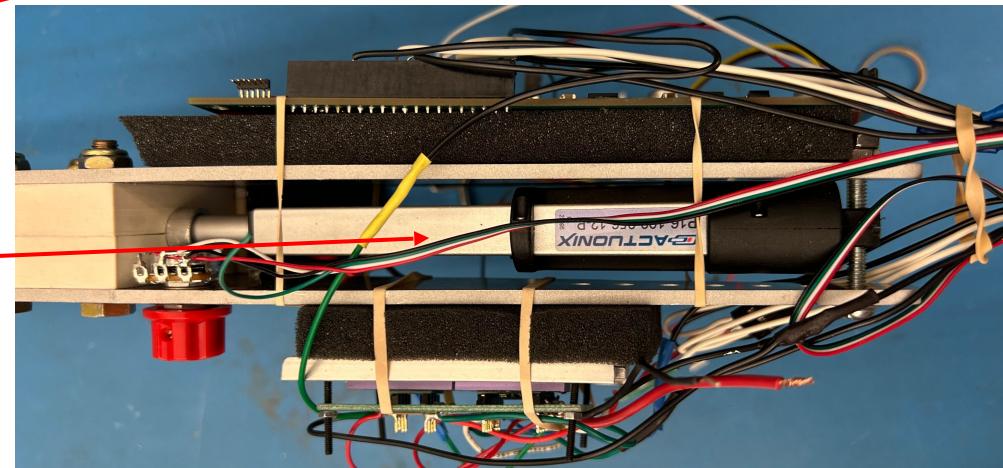
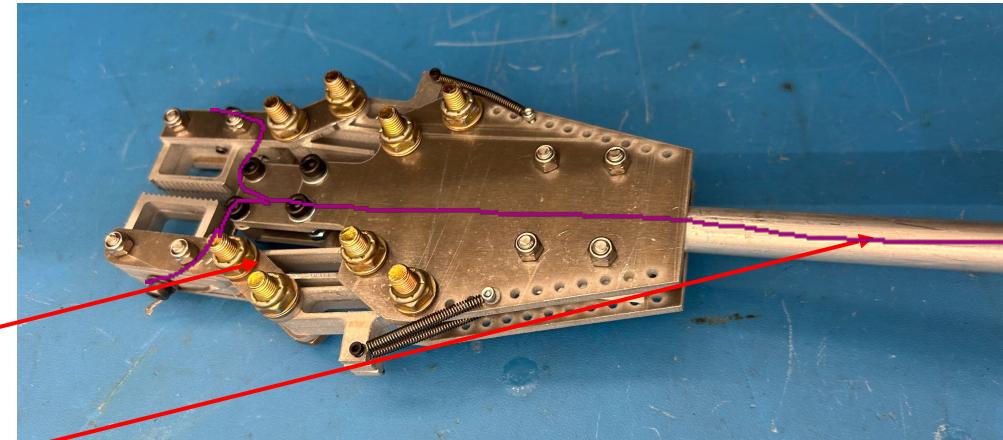
속도: 최대 7 m/s

하중: 최대 3 kg



# Summary

- Impedance control end-effector via current control
- 4-bar linkage gripper geometry
- Internal cable-driven gripper transmission, spring return
- Actuator: Actuonix P16-P
  - 12V, 1A (Continuous)
  - 300N max continuous force
  - Potentiometer position feedback
- Potentiometer Knob force “setting” control
- Trigger-switch engagement



# Control

- Actuator closed-loop current feedback control
- External pinching force-to-current correlation
- Force/current setpoint controlled by user-input potentiometer
- Actuator current reading with hall sensor



TMCS1107A4BQDRQ1  
Hall Sensor



Actuonix P16-P  
(256:1)



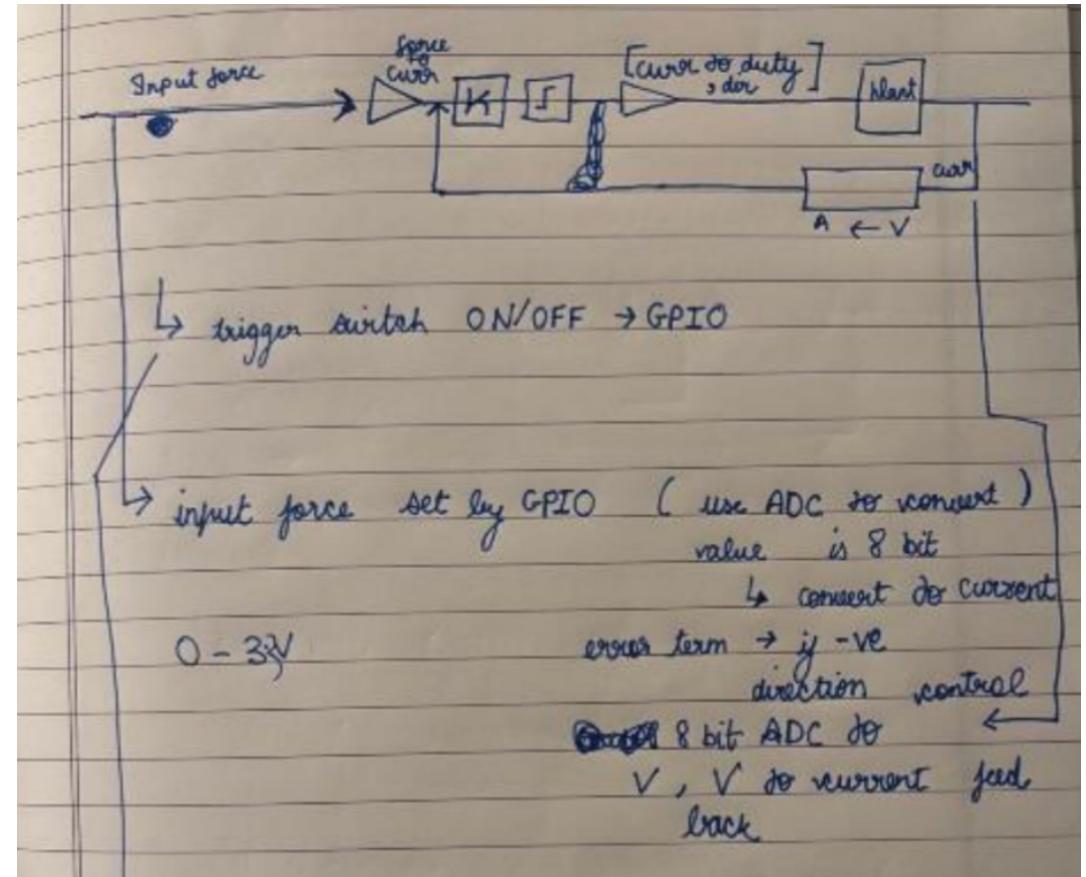
TB6612FNG  
Dual Motor  
Driver Carrier



Potentiometer

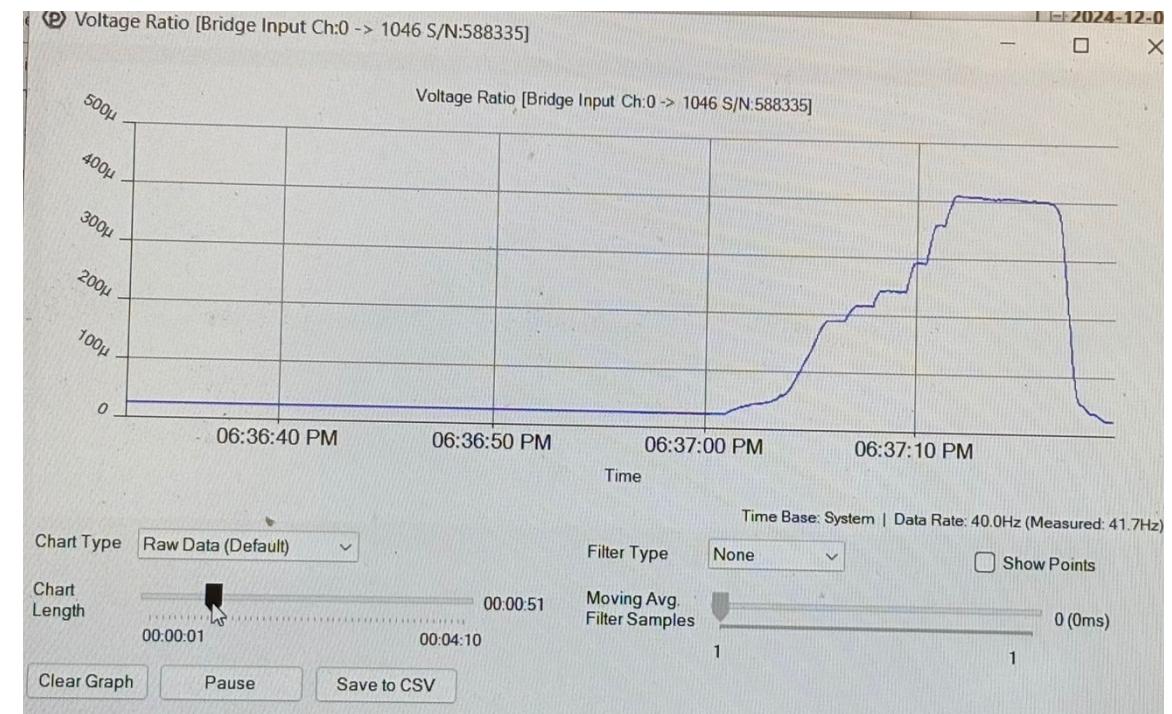


Trigger Switch



# Results

- Max Load: 150N Max Pinching Force
- Min Load: 10N Min (controllable) pinching force
- Impedance Control in gripping action but not releasing action
- Difficult to back-drive
  - Weak return springs
  - Very high internal gear reduction (256:1)
  - Relatively high-friction internal leadscrew/nut



# Improvements

- Velocity or position control under no-load then switch to impedance control when excess current is sensed
- Back-drivable or double-acting mechanism to allow for force control in both gripping and releasing
  - Remove the need for return springs that reduce max force output of the gripper