

Tuan Tai Nguyen<sup>1</sup>, Xuyang Zhang<sup>2</sup>, Quan Khanh Luu<sup>3</sup>, Van Anh Ho<sup>1</sup>, and Shan Luo<sup>2</sup>

<sup>1</sup>Japan Advanced Institute of Science and Technology (JAIST)

<sup>2</sup>King's College London

<sup>3</sup>Purdue University

**Introduction**

Inspired by the tip of the elephant's trunk, we present **EleTac**, a soft, vision-based tactile gripper that enables safe object grasping via a pinch-like motion and delivers high-resolution, full-surface tactile feedback for integrated proprioceptive and exteroceptive sensing.

**Gripper Design**

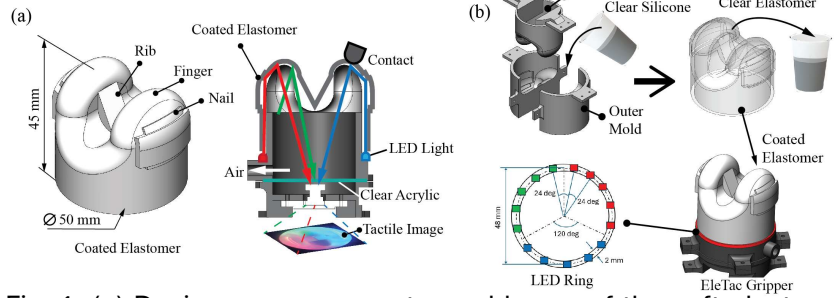


Fig. 1. (a) Design, measurements, and layers of the soft elastomer. (b) Fabrication process of the gripper.

**Grasping Performance**

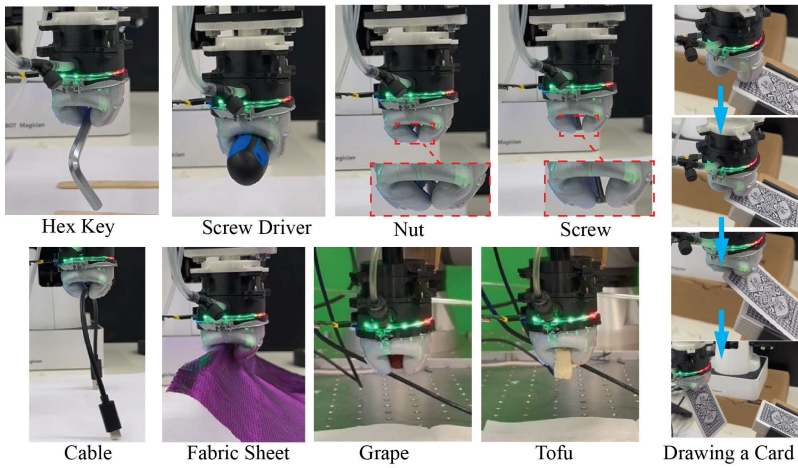


Fig. 2. Grasping demonstration.

Table 1. Grasping result

Object	Diameter / Width (mm)	Weight (g)	Success ( /10 )
Hex key (D=1.5)	1.5	< 10	7
Hex key (D=2)	2	< 10	9
Hex key (D=2.5)	2.5	< 10	10
Hex key (D=3)	3	< 10	10
Hex key (D=4)	4	13.93	10
Hex key (D=5)	5	24.47	10
Hex key (D=6)	6	29.55	10
Screwdriver	15	45.90	10
Pliers	14	54	-
Screw (D=3)	3	< 10	8
Nut (D=10)	10	< 10	10
Cable	4	14	7
Fabric	< 1 (thickness)	< 10	10
Half of tomato	8	< 10	10
Tofu (13 mm)	13	< 10	10
Tofu (14 mm)	14	< 10	-
Card drawing	< 1 (thickness)	< 10	9

**Tactile Sensing**

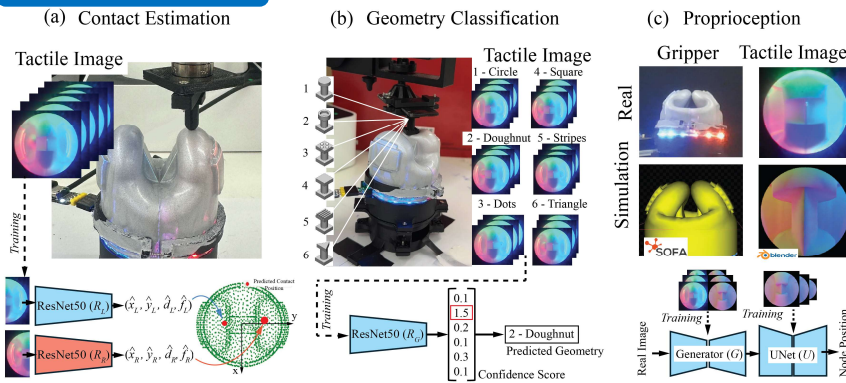


Fig. 3. Data collection for training tactile sensing models.

(a) Contact estimation. (b) Geometry classification. (c) Proprioception.

**Discussion**

- Grasping: The EleTac is suitable for small and lightweight objects (up to 45.9 grams).
- Average Contact Localization error is 2.36 mm for indentation depth > 4 mm.
- Average Geometry Classification accuracy is 81.67% for indentation depth > 4 mm.
- Average Proprioception error is 2.87 mm.

**Future Work**

- Improve sensing accuracy.
- Develop a full-length elephant trunk robot.

**Application**

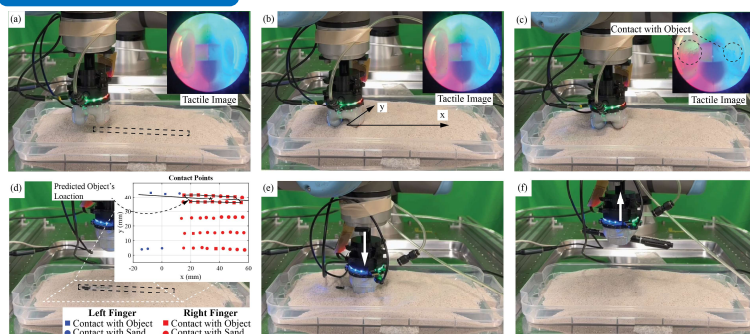


Fig 4. Excavation of an object buried in a granular material.

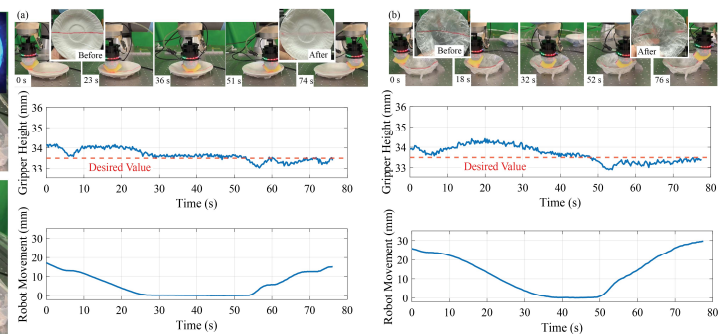


Fig 5. Adaptive surface-following.