Hardware Integration of a Universal Gripper to the Roombot

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Denisart Théo-Tim

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Supervisors: Simon Hauser, Mehmet Mutlu

Professor: Auke Ijspeert

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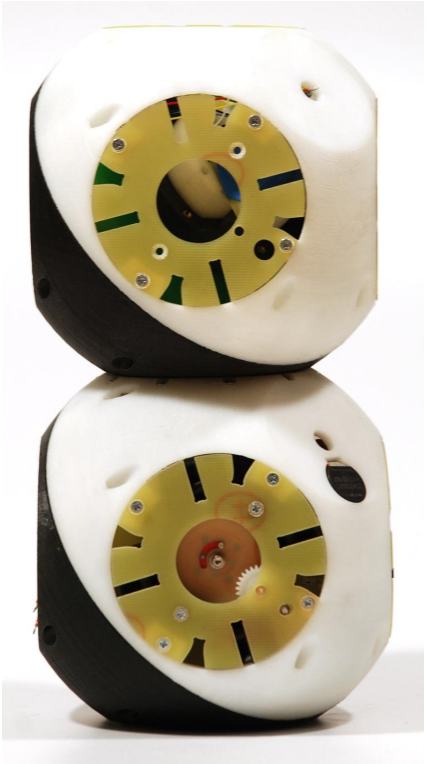
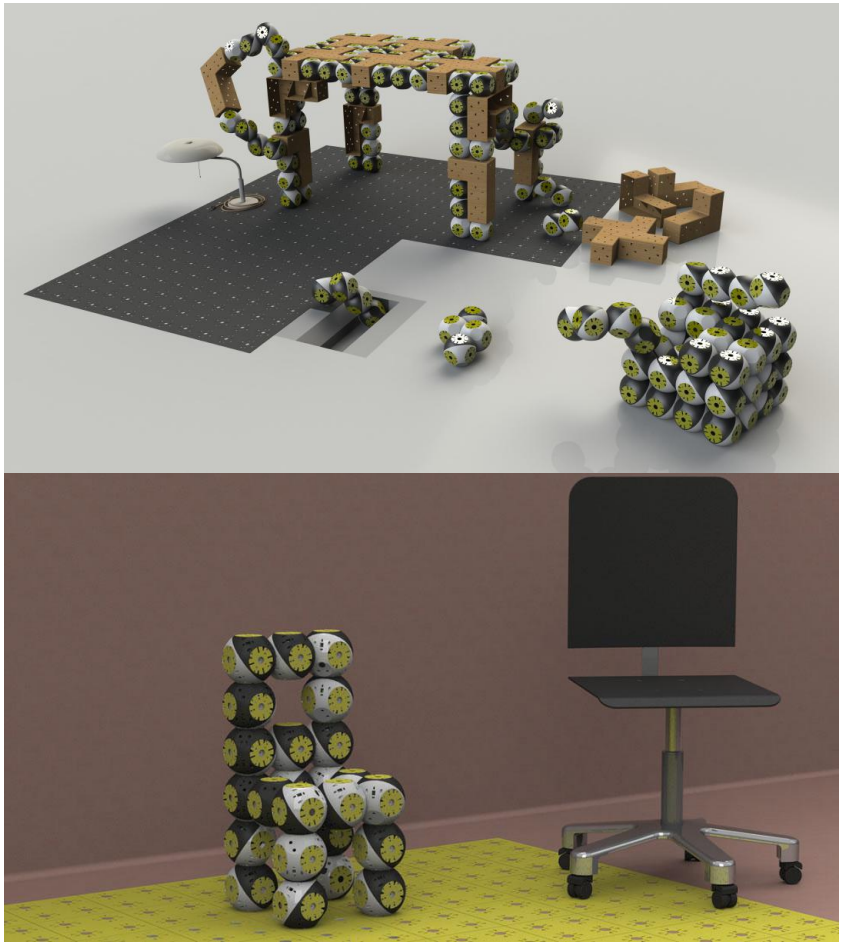
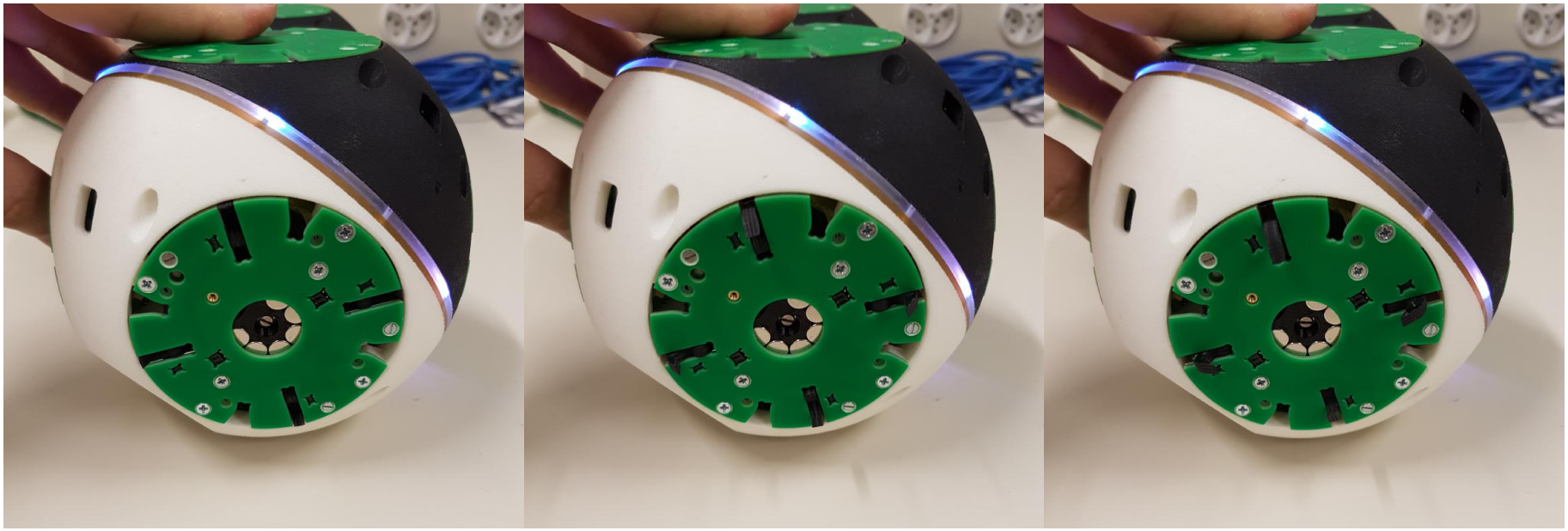
Introduction





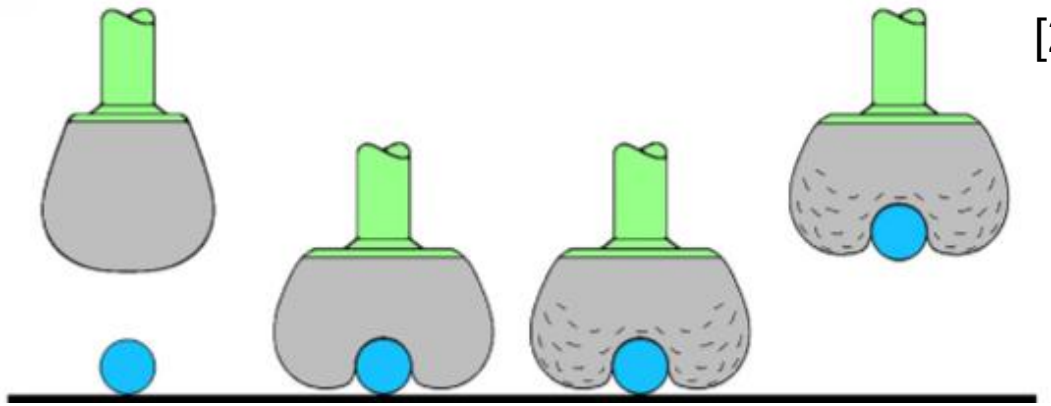
Goal 1

- Increase manipulative capabilities of the Roombots

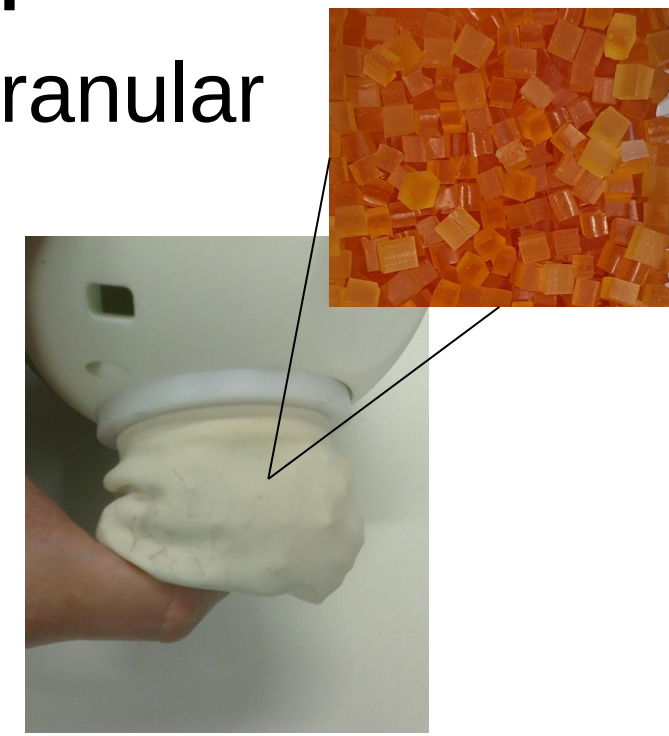


Universal Gripper

- Works on the jamming of granular media

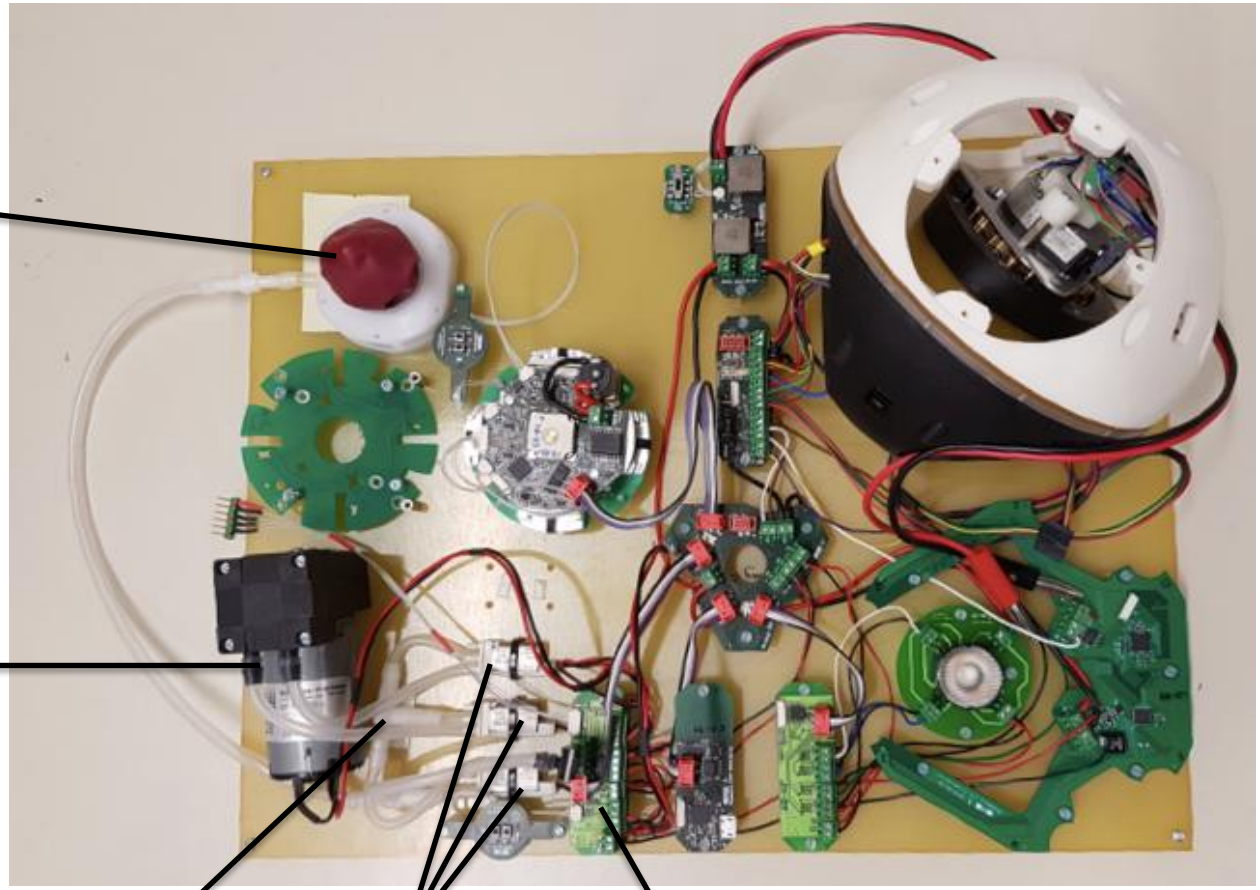


[2]



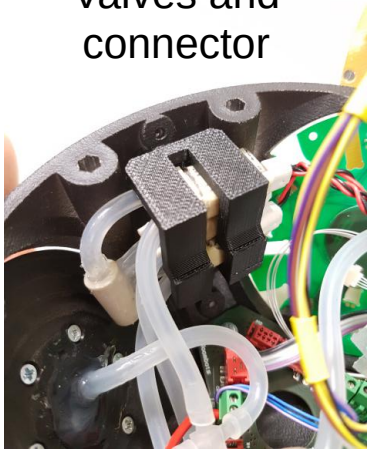
- Capability to interact with a wide range of objects
- Compliant gripping: Human interaction

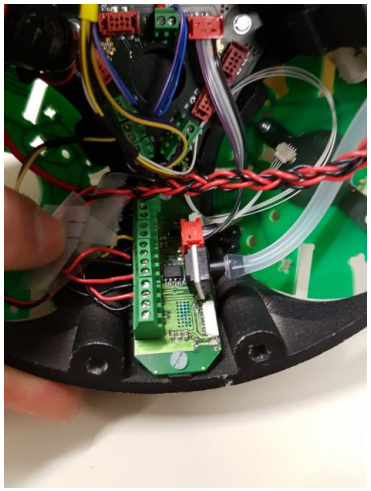
Design



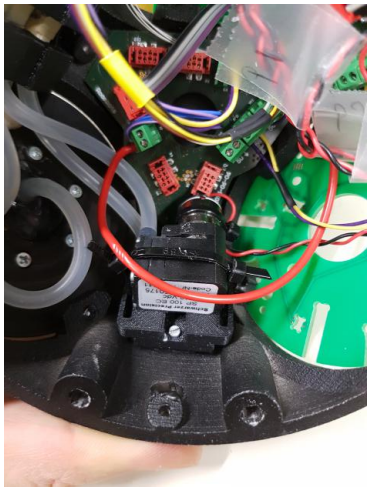
Design

Valves and connector

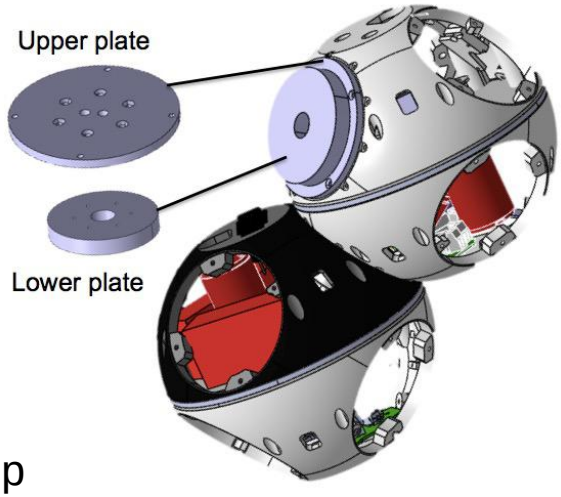


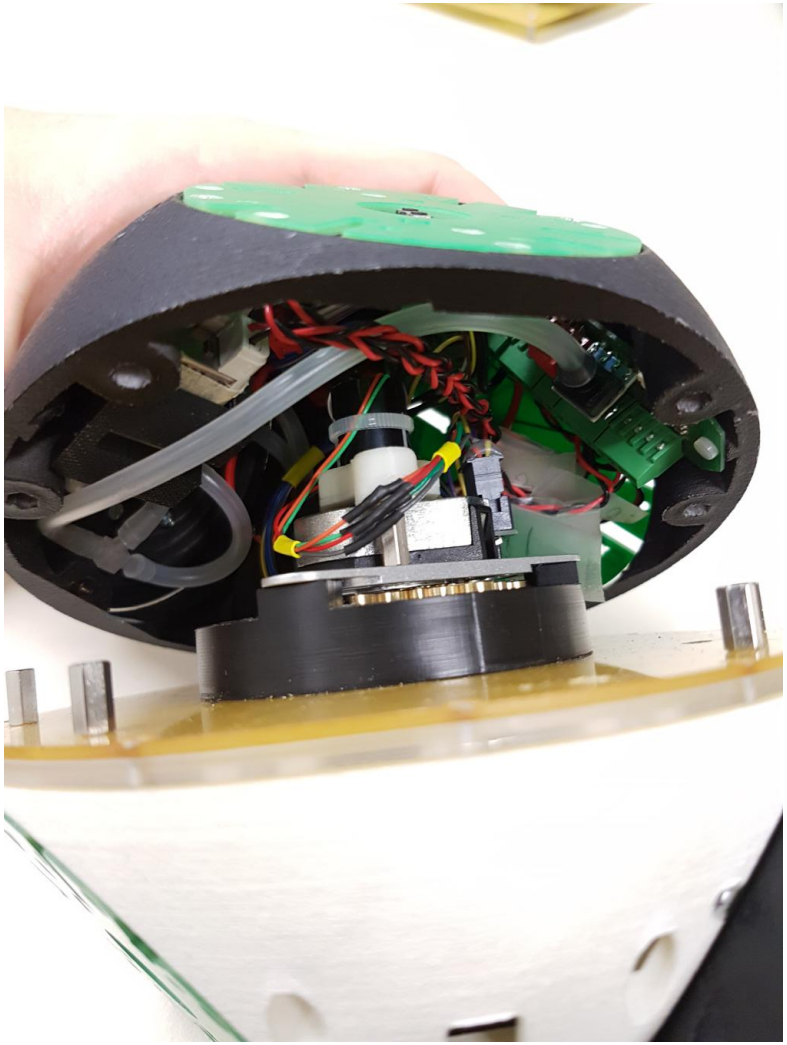


PCB



Pump

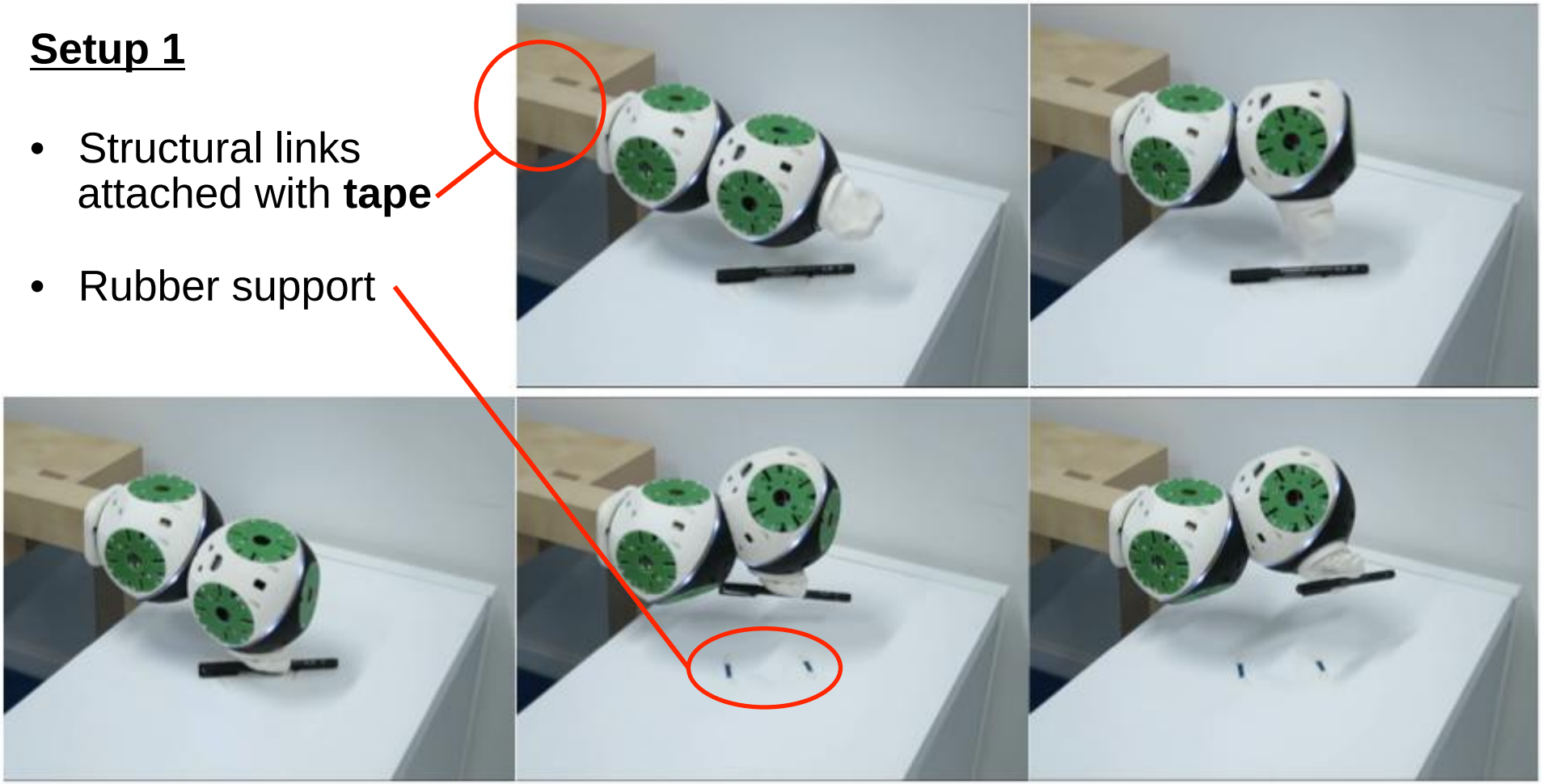




Setup Iteration

Setup 1

- Structural links attached with **tape**
- Rubber support

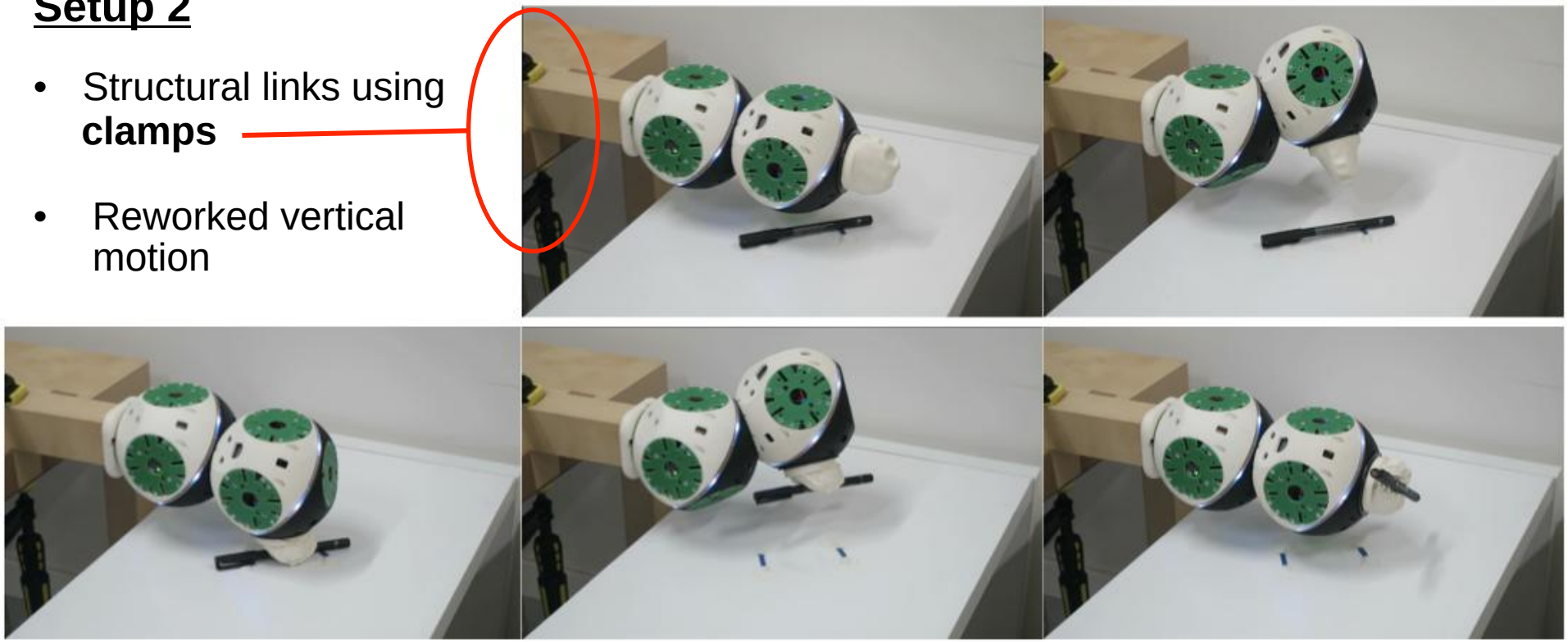


➔ **Success rate: 16%**

Setup Iteration

Setup 2

- Structural links using **clamps**
- Reworked vertical motion

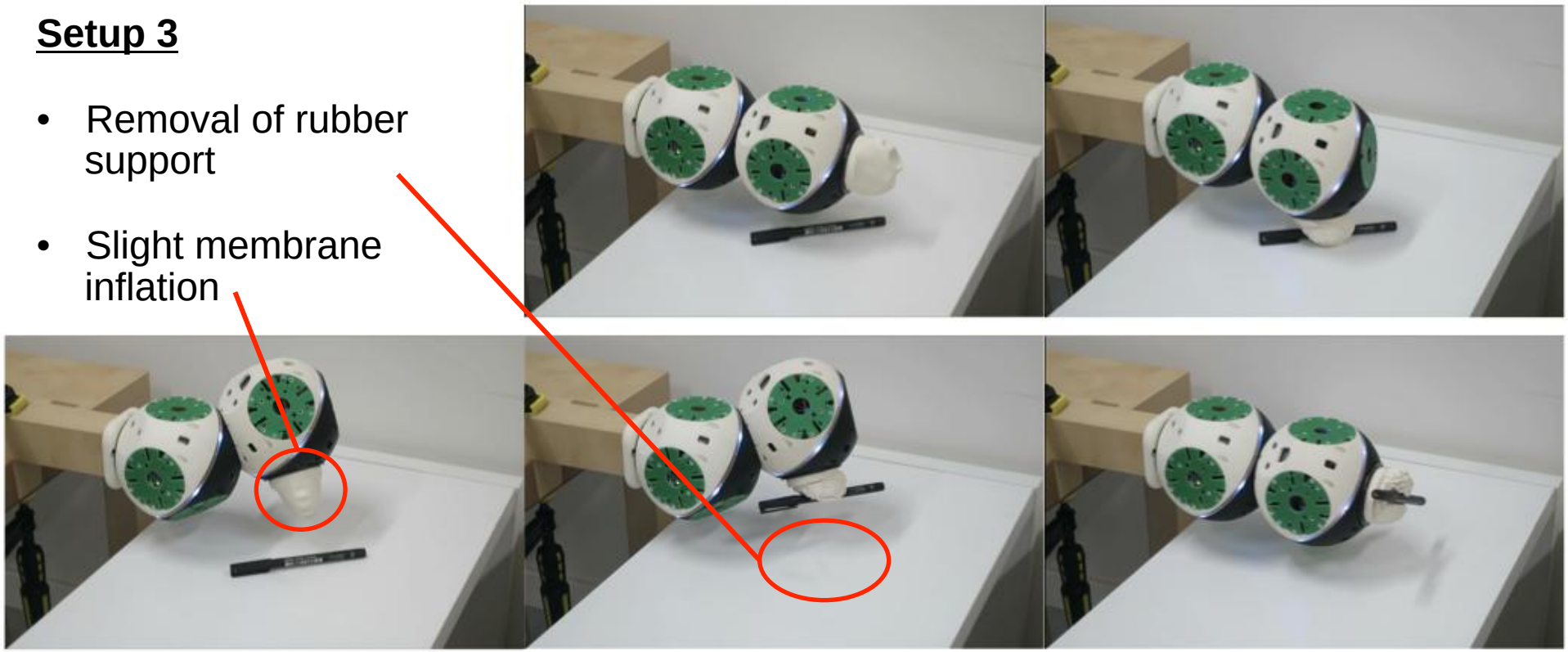


➔ **Success rate: 100%**

Setup Iteration

Setup 3

- Removal of rubber support
- Slight membrane inflation

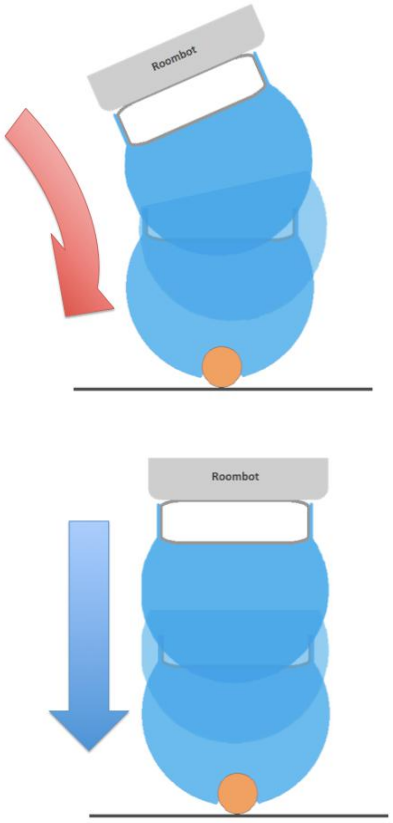


➔ **Success rate: 100%**

Picking up a Pen

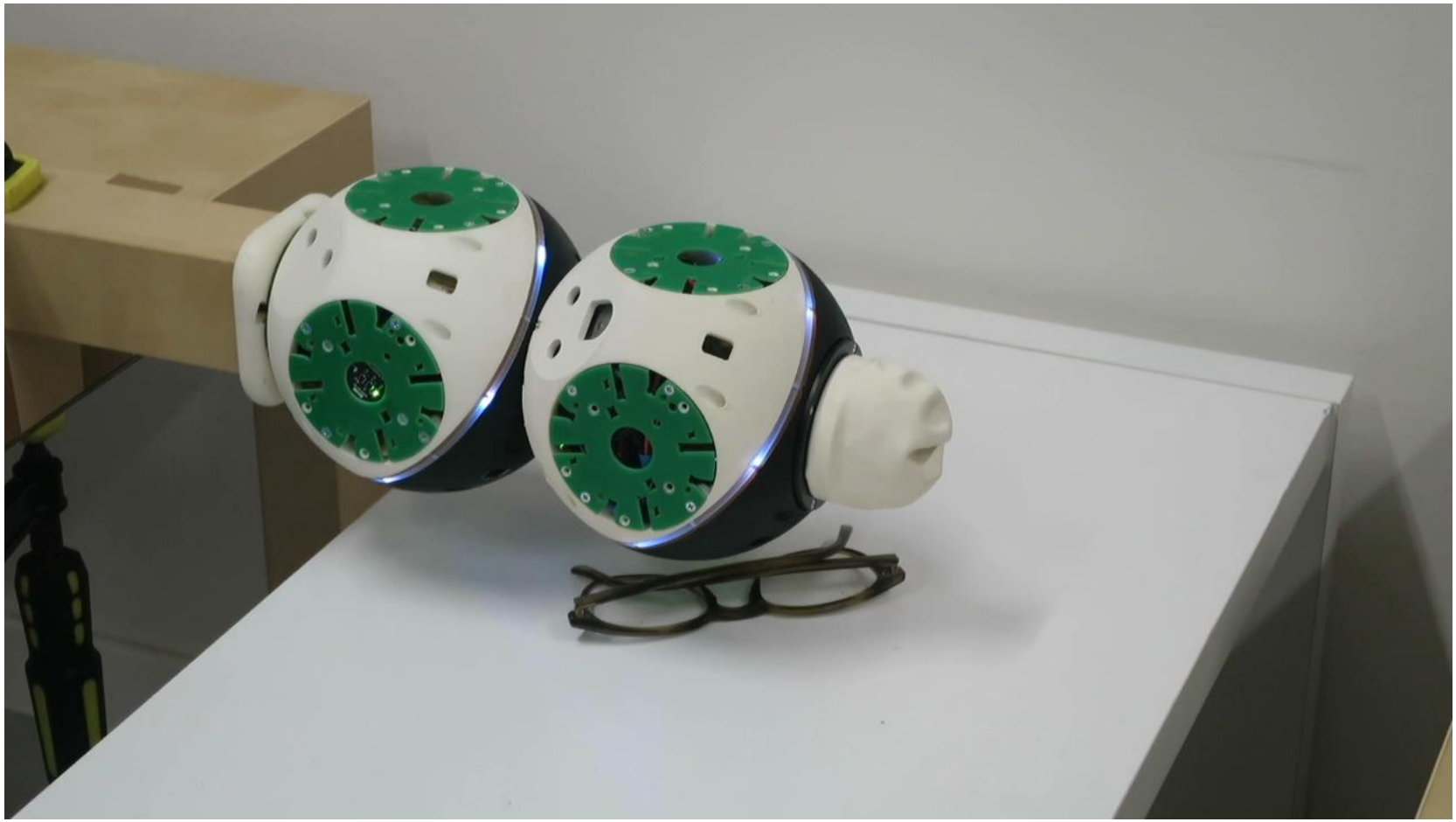
Observations

- Pressure onto the object
- Strong structural link
- Vertical motion
- Slight membrane inflation



➔ 100% success

Applications



Conclusion

- Integration into the Roombot
- Untethered universal gripper
- Wide new range of interactions and applications for the Roombots (objects, human)

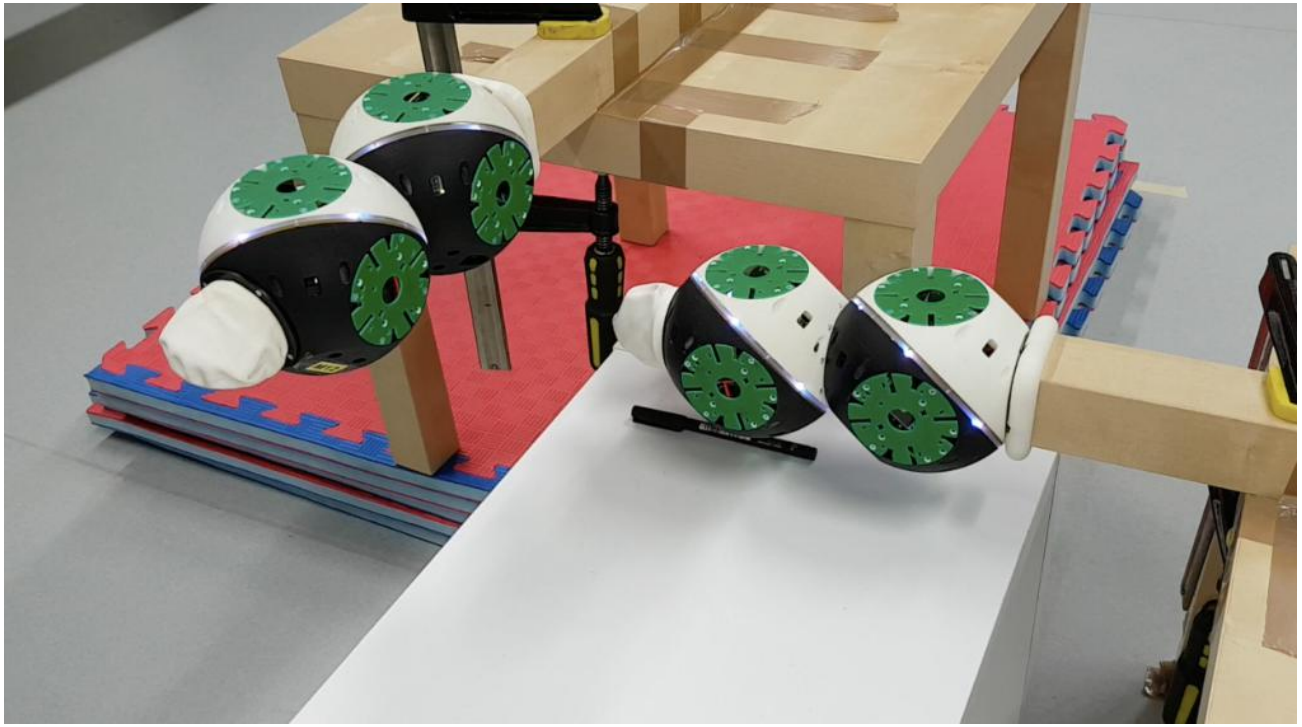
Introduction Goal 2

Object passing in robotic:

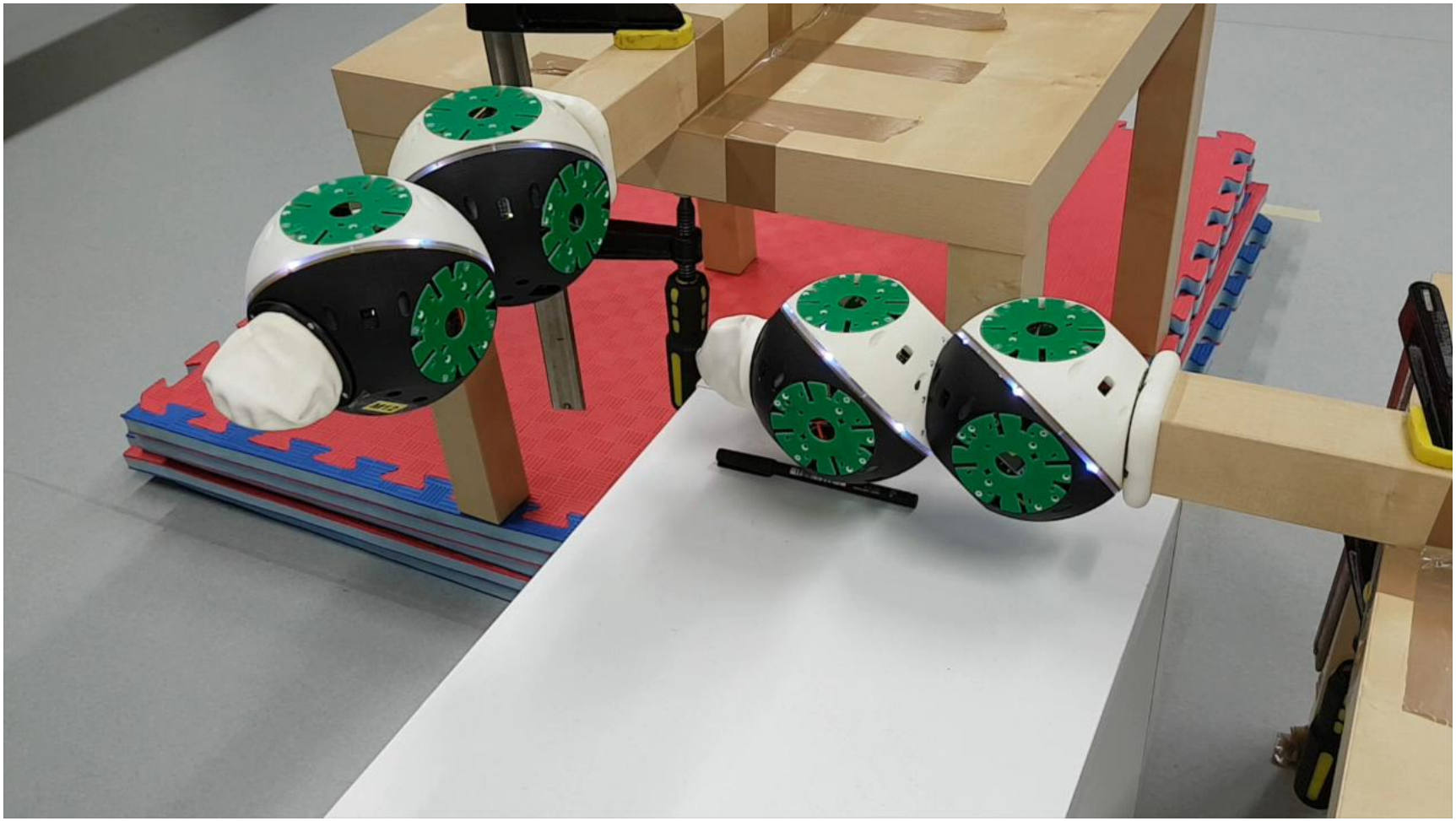
- Complex control
- Computational cost
- Orientation sensitive

Goal 2

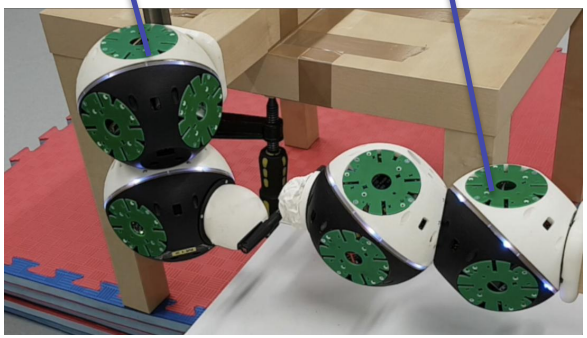
- Mid-air object passing between two Roombot modules



Object passing

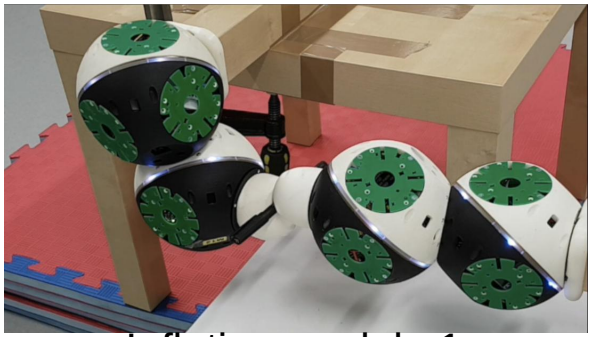


Strategy



Inflation module 2

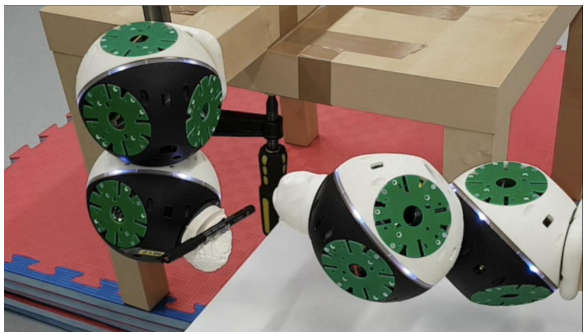
Contact between modules



Inflation module 1

Movement module 2

Air suction module 2



Object pickup

Conclusion

Object passing:

- Novelty in modular robotic
- Innovative strategy that doesn't require high precision

Future Work

Object pickup:

- Influence of parameters (membrane, granules, etc...)

Object passing:

- Conditions for object passing (motion, strategy, direction, type of objects, etc...)

Thank you !

Questions?

References

- Simon Hauser, Peter Eckert, Alexandre Tuleu and Auke Ijspeert, Friction and *''Damping of a Compliant Foot Based on Granular Jamming for Legged Robots''*, IEEE RAS/EMBS International Conference on Biomedical Robotics and Biomechatronics (BioRob) June 2016.

- Allen Jiang, Georgios Xynogala, Prokar Dasgupta, Kaspar Althoefer and Trishantha Nanayakkara, *''Design of a Variable Stiffness Flexible Manipulator with Composite Granular Jamming and Membrane Coupling''*, IEEE/RSJ 2012

- Allen Jiang, Asghar Atoallahi, Kaspar Althoefer, Pokar Dasgupta, Thishantha Nanayakkara, *''A Variable Stiffness Joint by Granular Jamming'',* IDECT/CIE August 2012.

- John R. Amend, Jr., Eric Brown, Nicholas Rodenberg, Heinrich M. Jaeger, and Hod Lipson, ''*A Positive Pressure Universal Gripper Based on the Jamming of Granular Material''* in IEE Transactions on Robotics, VOL. 28, No 2, April 2012.

- Design and Analysis of a Robust, Low-cost, Highly Articulated manipulator enabled by jamming of granular media. Cheng, Nadia G., et al., et al. 2012, 2012 IEEE International Conference on Robotics and Automation (ICRA), pp. 4328- 4333.

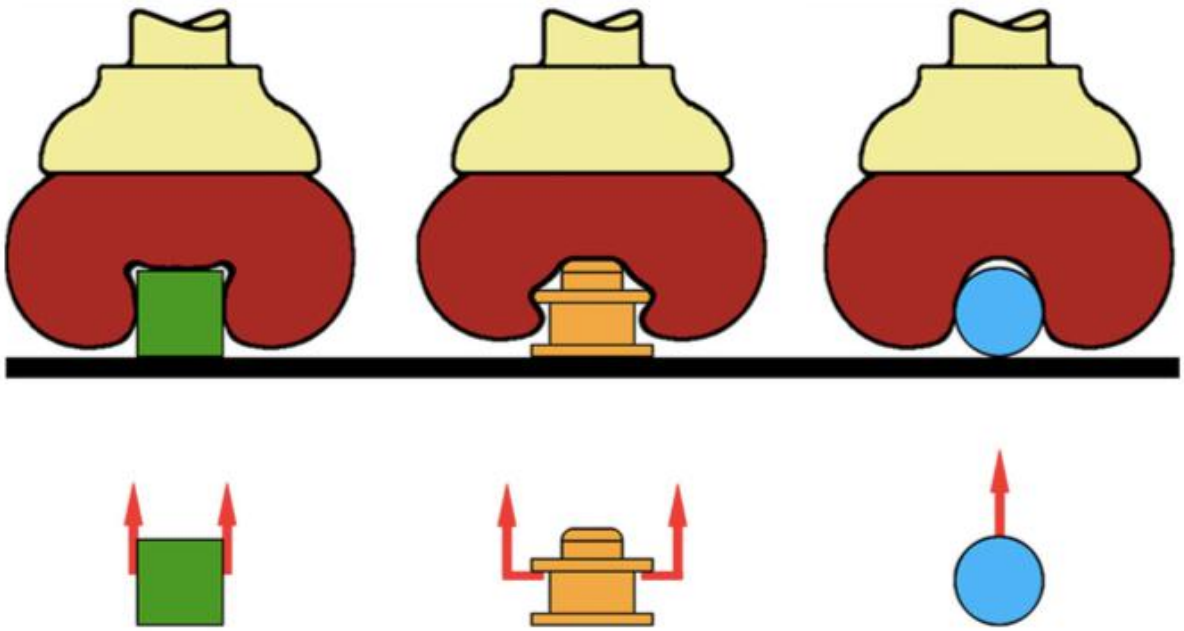


Fig. 2. A universal jamming gripper can achieve three separate gripping modes. (Left) Static friction from surface contact. (Center) Geometric constraints from interlocking. (Right) Vacuum suction from an airtight seal. Normally, it would be unlikely that the interlocking or vacuum modes would be achieved without some additional contribution from friction.

Setup 1	
Dropped	Picked Up
1	
	1
1	
1	
	1
1	
1	
1	
1	
1	
1	
1	
1	
1	
1	
1	
1	
1	1
1	
Success	**15.79%**

Setup 2	
Dropped	Picked Up
	1
	1
	1
	1
	1
	1
	1
	1
	1
	1
	1
	1
	1
	1
	1
	1
Success	**100%**

Setup 3	
Dropped	Picked Up
	1
	1
	1
	1
	1
	1
	1
	1
	1
	1
Success	**100%**