Pneumatic Granular Jamming End-Effector for Niryo Ned2

By

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The functional part of the device is a latex balloon filled with coffee grounds. To integrate this into the robot, a 3D printed holder was designed. It consists of a balloon socket. It is a small cup-shaped piece where the balloon sits partially inside, with an opening that allows it to protrude and contact objects. The top side of the part is an adapter that connects the socket to the Niryo's wrist mount. The adapter then has an opening at the top where magnet can be inserted so socket can snap in, allowing for quick assembly or replacement of the gripper.

The jamming gripper was modelled in SolidWorks based on compatibility with the Niryo Ned2. As shown in Figure 1, the design includes a central chamber to hold the latex balloon and coffee grounds, with a port for the vacuum line. The conical shape aids in forming a tight seal when grasping flat or curved surfaces.

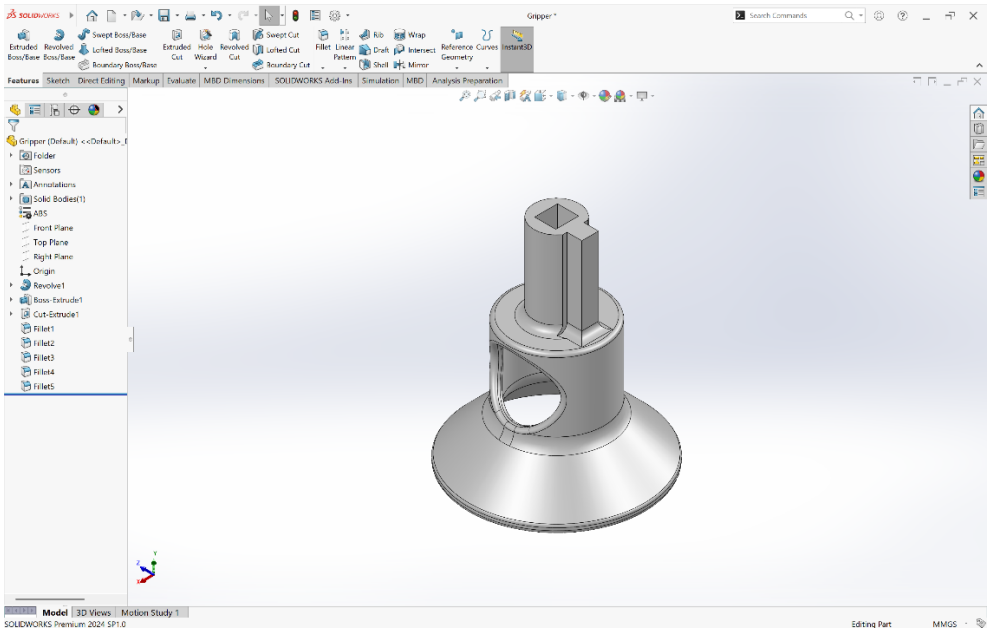

Figure 1: CAD Model of the Pneumatic Granular Jamming Gripper

To actuate the granular jamming gripper, a mini vacuum pump was used. As shown in Figure 2, the pump connects to the latex membrane via 6mm pneumatic tubing that control suction and release. This setup enables rapid stiffening and softening of the gripper based on operator input.

Figure 2: Electric Air Pump Used for Gripper Vacuum Actuation

To interface the air pump's large nozzle with 6mm pneumatic tubing, a custom adapter was designed and 3D printed. As shown in Figure 3, the part includes a tight-fitting cylindrical base and a stepped barbed end to grip 6 mm tubing. This solution eliminated air leaks and removed the need for glue or clamps, enhancing modularity.

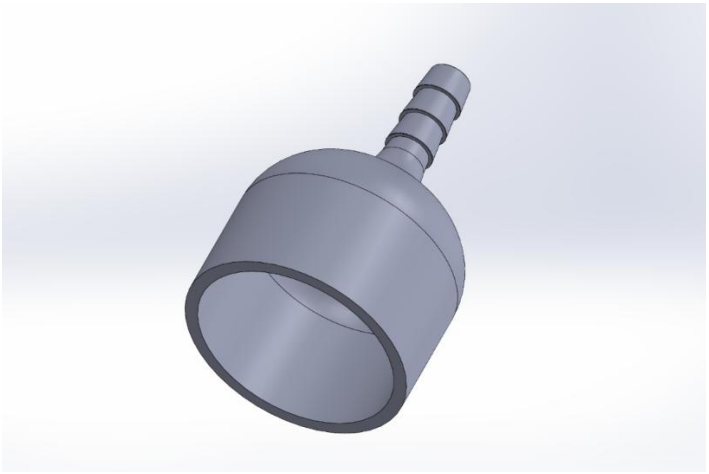

Figure 3: Custom 3D-Printed Adapter for Compressor to Pneumatic Tubing

To protect the pneumatic system from particulate ingress, a 6 mm inline air filter was installed between the pump and the gripper. As shown in Figure 10, the transparent housing allows visual inspection for clogging. This low-cost solution improved system reliability during multiple grip cycles using ground coffee.

Figure 4: Inline Air Filter for Pneumatic Circuit Protection

The pneumatic gripper assembly, including the vacuum pump, granular jamming gripper and Inline Air Filter was successfully integrated with the Niryo Ned2 robotic arm as shown in Figure 5. This configuration enables precise actuation of the gripper through vacuum control.

Figure 5: Granular Jamming Gripper Assembly connected to the Niryo Ned2 Robotic Arm

Figure 6: Granular Jamming Gripper holding Barbed Adapter