

# Grasping Robot Integration and Prototyping: The GRIP Software Framework

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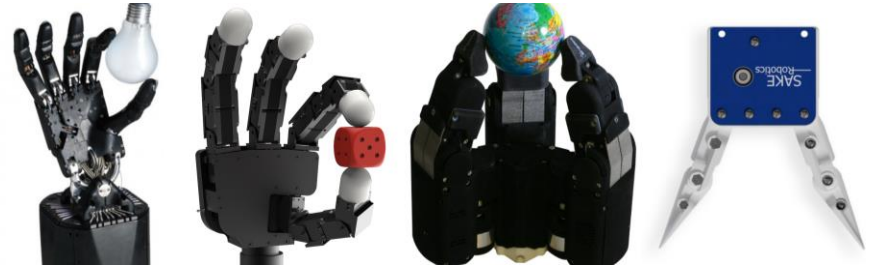
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# Robotic grasping and manipulation

An unsolved, yet fundamental skill required in many real-world applications. An active field of research proposing new solutions related to

- Hardware
- Software
  - Low-level (controller, planner, etc.)
  - High-level (grasp pose detection, etc.)



Example of robot end effector capable of grasping and/or manipulation tasks



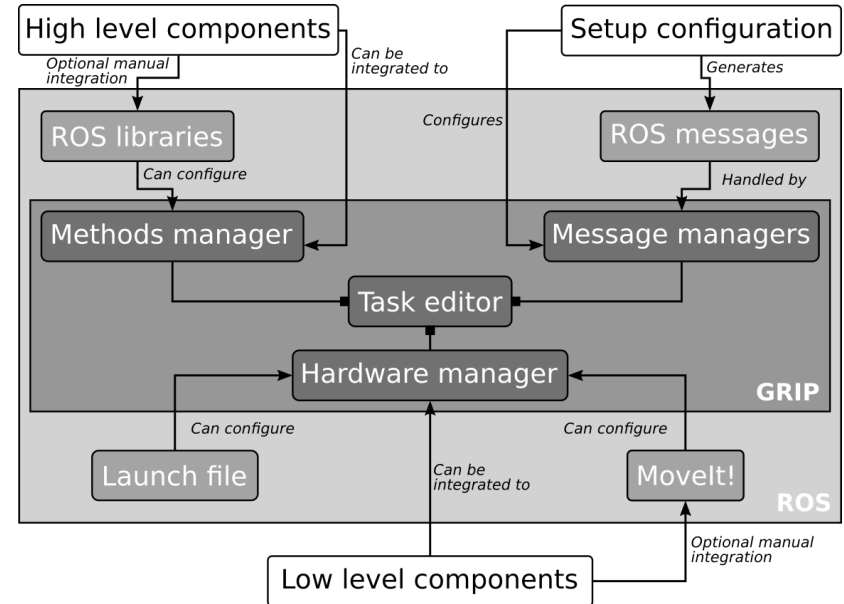
Example of some RGBD sensors

Example of some tactile sensors

# The GRIP Software Framework - Overview

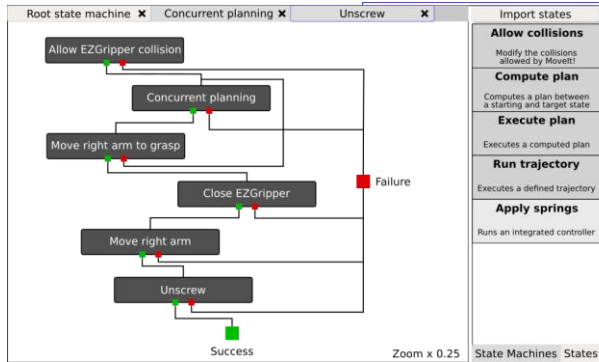
- **ROS-based** open-source framework to quickly and easily design robot manipulation tasks with integrated components
- Integration of software and hardware components made flexible
- Reactive and intuitive GUI guiding the user from robot integration to task execution
- **Not** meant to be an optimized and high-performance pipeline

Documentation available online at <https://sr-grip.readthedocs.io/en/latest/>

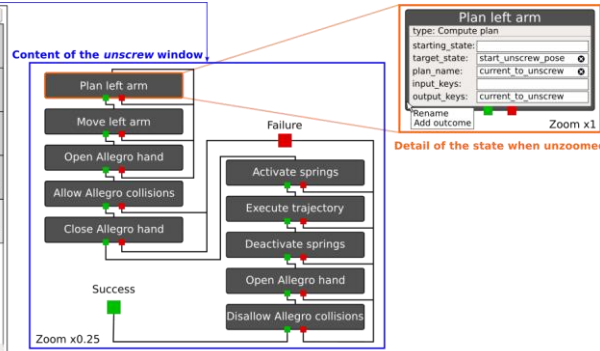


Overview of the GRIP framework, allowing users to configure a robot and a task from integrated components

# The GRIP Software Framework – Task design



Abstract view of the task editor allowing the user to design the task graphically



```
joint states* New Open Save Save as Close
initial_pose:
shoulder_pan_joint: 3.141592654
shoulder_lift_joint: -1.655968394
elbow_joint: 1.3870131566
wrist_1_joint: -1.2662363723
wrist_2_joint: -1.5707963268
wrist_3_joint: 0

mid_pose:
shoulder_pan_joint: 1.5707963268
shoulder_lift_joint: -1.5707963268
elbow_joint: 1.5707963268
wrist_
wrist_2_joint ← Autocompletion
wrist_3_joint
```

```
Poses* New Open Save Save as Close
+kinect2_pose:
reference_frame: world
position: {x: -0.1645, y: 0.375, z: 1.5}
# You can change r,p,y to x,y,z,w for quaternion
orientation: {r: 3.141592654, p: 0, y: 1.570796}

Sensor config* New Open Save Save as Close
+fixed_kinect2:
data_topics:
pointcloud: /kinect2/sd/points
depth_map: /camera/depth/image_depth
rgb: /kinect2/sd/image_color_rect
initial_pose: kinect2_pose

wrist_realsense:
data_topics:
pointcloud: /camera/depth/color/points
depth_map: /camera/depth/image_raw
rgb: /camera/color/image_raw
initial_pose:
frame_id: camera
reference_frame: ee_link
position: {x: 0.08, y: -0.05, z: 0.05}
orientation: {r: 3.141592654, p: 0, y: 0}
```

Reactive mechanisms implemented to help users successfully configure the setup

## Graphical programming paradigm

- State machines and states provided by GRIP
- Possibility to add new elements

# Use-case: Visuo-tactile closed-loop grasping for precise placing of objects



Robot setup composed of:

- Universal Robot 5
- EZGripper – Sake Robotics
- uSkin sensor – Xela Robotics
- Kinect version 2

High level methods to run:

- Vision based grasp pose detection [1]
- Slip detection [2]

Robot and sensors to integrate to GRIP in order to carry out the closed-loop grasping



# References

[1] T. Suzuki and T. Oka, "Grasping of unknown objects on a planar surface using a single depth camera", in 2016 IEEE International Conference on Advanced Intelligent Mechatronics (AIM), IEEE, 2016.

[2] R. Zenha et al., "Tactile Detection in the Wild Leveraging Distributed Sensing of both Normal and Shear Forces", in 2021 IEEE International Conference on Intelligent Robots and Systems (IROS), IEEE/RSJ ,2021.

GRIP documentation: <https://sr-grip.readthedocs.io/en/latest/>

B. Denoun et al., "Grasping Robot Integration and Prototyping: The GRIP Software Framework", in 2021 IEEE Robotics and Automation Magazine, IEEE, 2021.

**Thank you**



**Queen Mary**

**University of London**

Science and Engineering