UR5 Obstacle-Avoidance Pick-and-Place with Arm Assistance
Weekly Progress Report 5
Yucheng Kang, Zhiyi Ren
May 01, 2018

- This Week's Goals
  - Implement intermediate pose input for moveit planning
  - Implement hand orientation and gesture detection.
  - Integrate arm tracking, and motion planning
- This Week's Progress
  - Gesture Recognition
    - We implement a simple gesture recognition with OpenCV. It detects the number of fingers via convexity. The following figure shows the ROI (yellow), the contour (green), the defects (red), and the classification (black).
    - This result will be used as user command, e.g. setting intermediate pose, teleoperation, etc. Because of the lighting, the gesture recognition is not very stable for now.

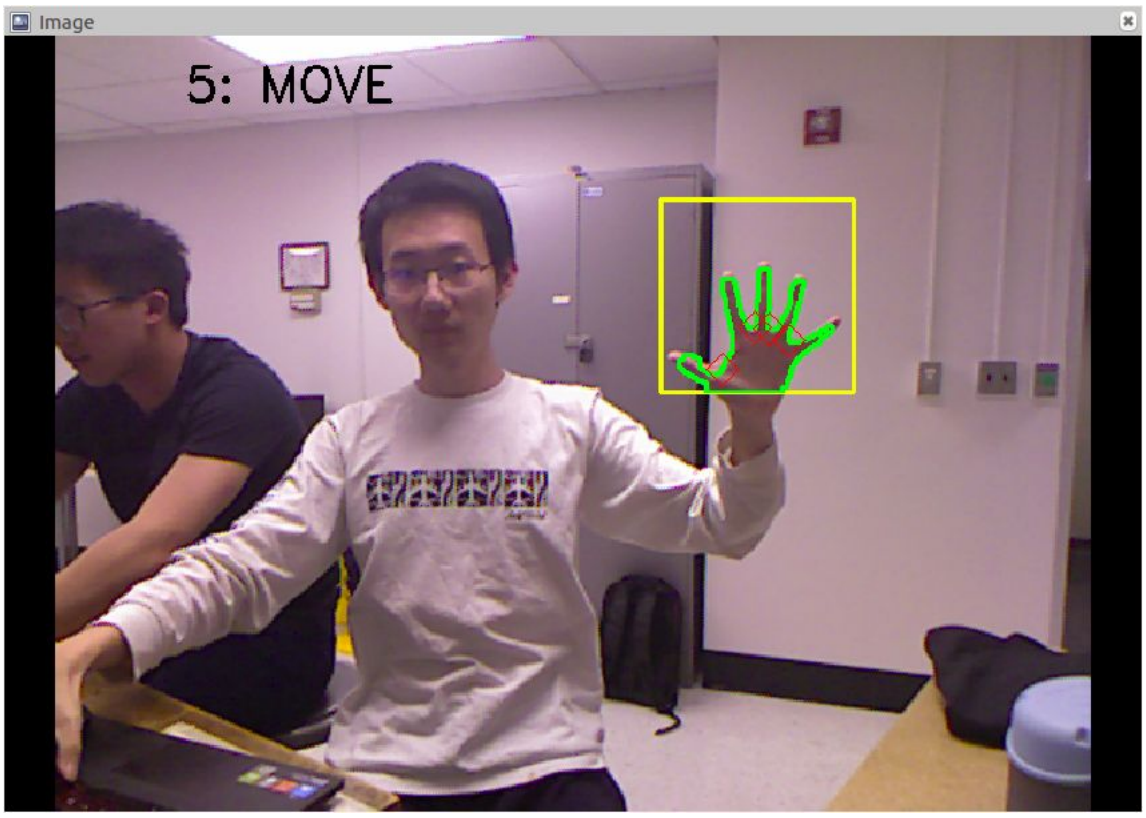

Fig. 1 Gesture recognition result

- Aruco tracking
  - We put Aruco tags on three cubes and a target plate. Since our camera is moving, it may not see all the tags all the time. We created a new node based on aruco_ros source file that always publishes the transform from base_link to markers even when the camera does not see the marker, using older transforms. This is ok since the markers do not move.

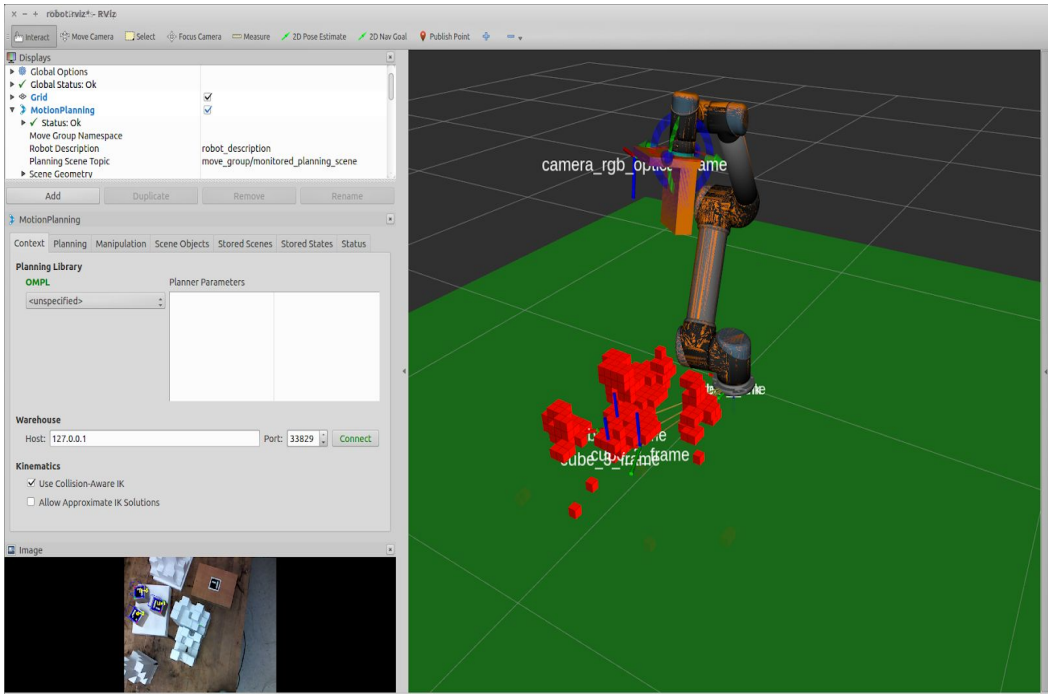

Fig. 2 Rviz showing moveit and aruco tags

- central control
  - During pick-and-place operation, it is essential for the central node to know when the UR5 task is finished, so that it can send the next command. We implemented a simple action server/client between central node and planning node.
- Hand-eye calibration
  - We finished a thorough hand-eye calibration for R200 camera on UR5. Now the launch file publishes the static transform.
- obstacles
  - We found some regular-shaped obstacles from our research lab.

Fig. 3 Obstacles

- Changes in Project Scope/Goals
    - No changes.

- Lessons learned
    - The color-based skin detection is not very robust, especially when you are sitting under a lamp.
    - tf::loopupTransform does not work in aruco image callback.

- Next week's goals
    - Most components are done. We need to test and integrate all of them.
    - Record some videos.