Object Detection and Pose Estimation in Robot Bin Picking

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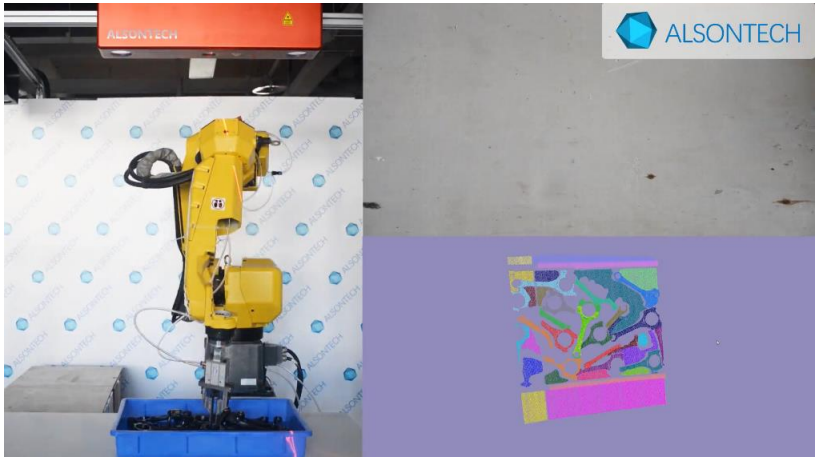
Background

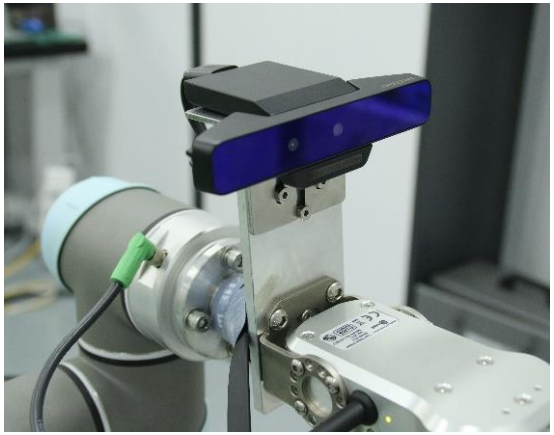


Industrial automation

warehouse automation

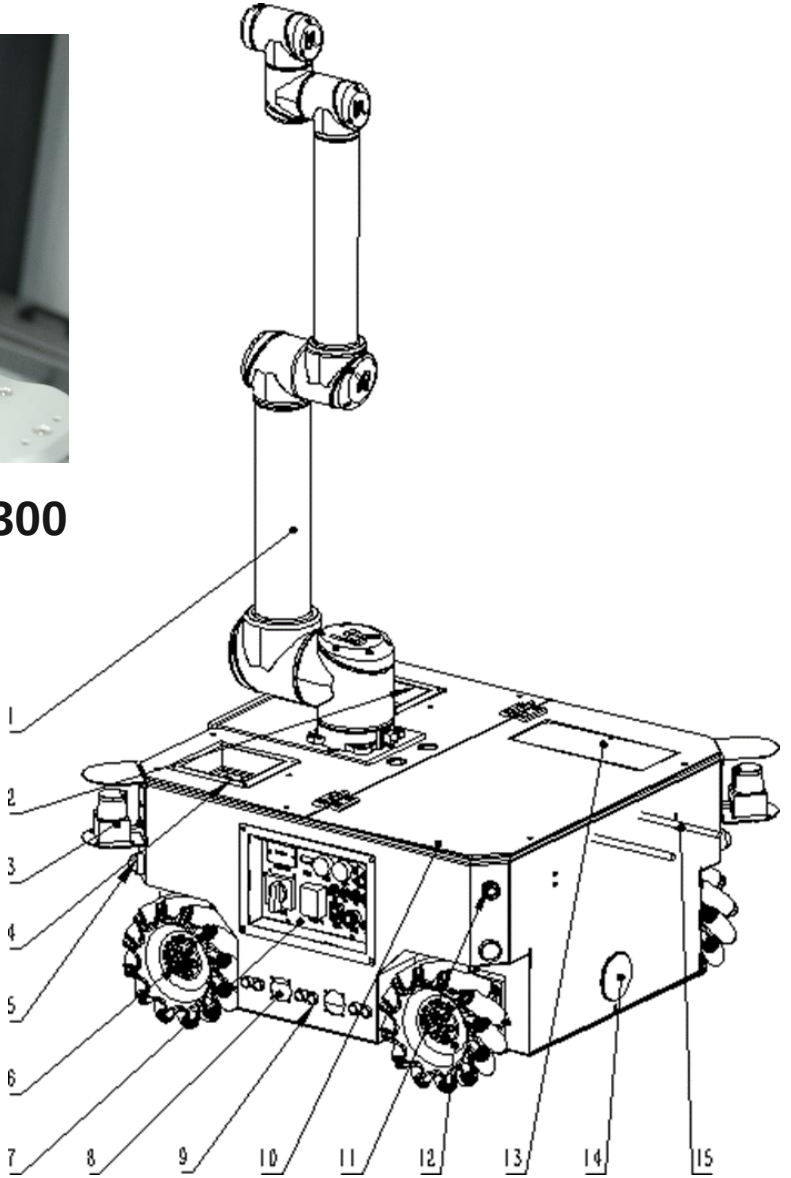
Hardware System

Move Base and Robot



Camera Realsense-300

Enviroment



Object Detection and Pose Estimaton Process

Calibration

Realsense camera capture the RGB and depth image.

Depth Image of the Scene

Projection

RGB and depth image aligment

Depth image

Mask RCNN Segmentation

RGB Image of the Scene

Mask RCNN image segmentation

Mask of the scene

Object point Cloud image

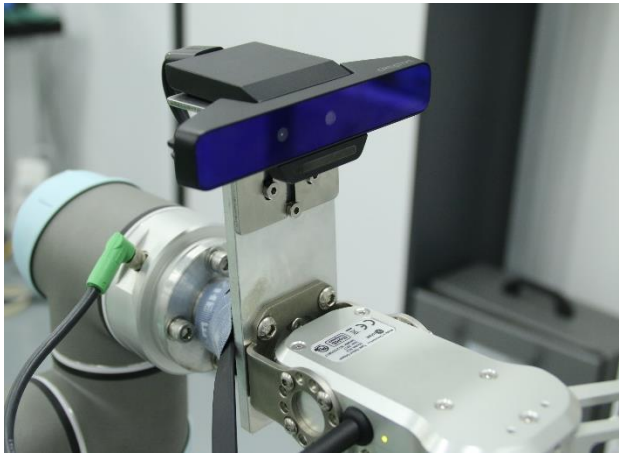
Depth image to Point Cloud

PCA search minimum bounding box,estimate object pose

Object pose none if absence

PCA pose Estimation

Camera calibration and hand-eye calibration



Camera Calibration:

Opencv、 Chessboard

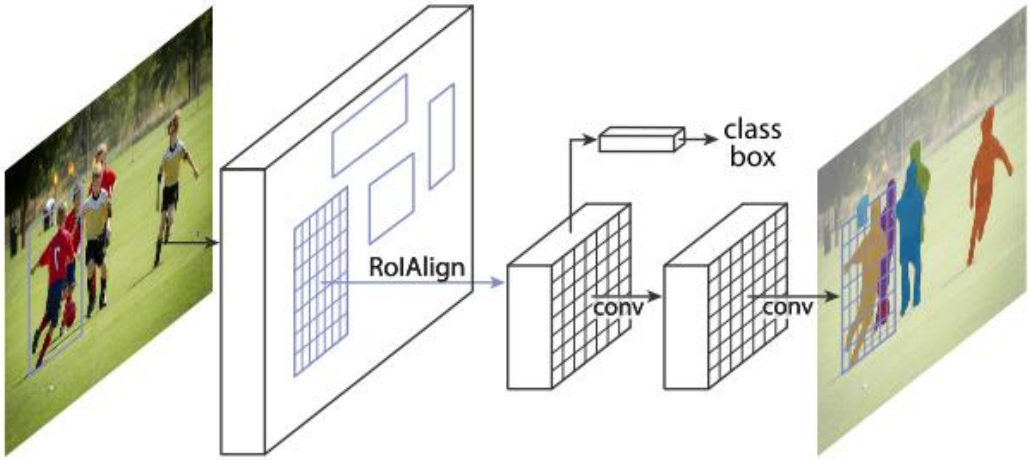
Hand-eye Calibration:

ROS Pacakge： easy-hand-eye

Aruco Marker

Object Detection

Mask R-CNN:



Advantages of Mask R-CNN:

1) effective in detecting objects
2) generate the segmentation mask of every instance with high quality
3) has good generalization and is easy to be transformed to other tasks

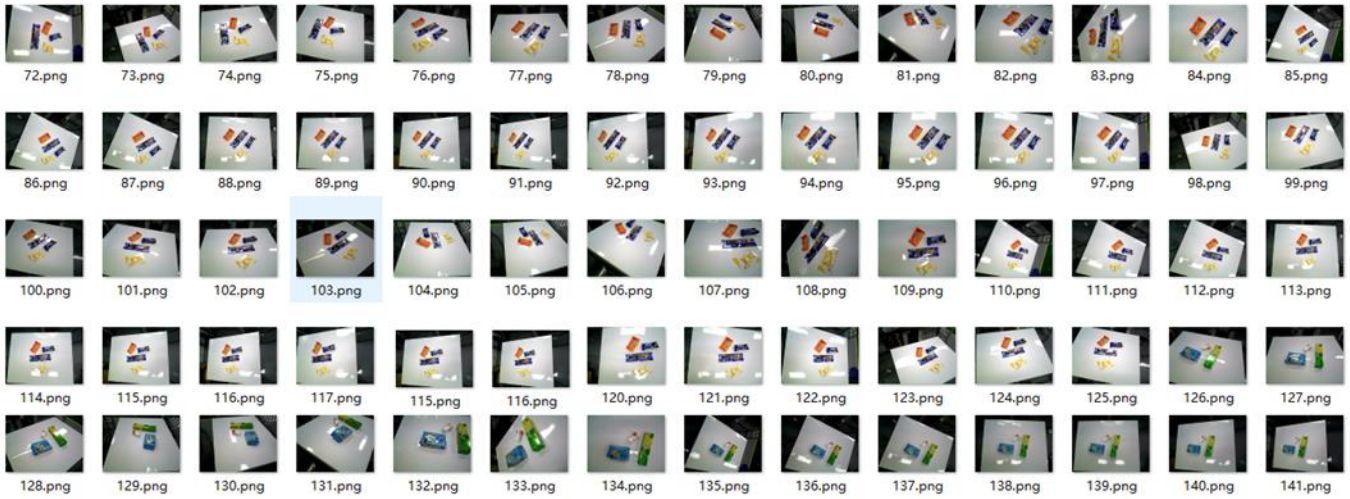
Training data Collection

- **18 categories**

Calcium tablets
Calcium tablets sticker
Fries
Sausage
Shampoo
Cap of shampoo
Teething stick
Oreo
Chips
Paper
Biscuits
Toothbrush
Toothpaste
Book
Guozhen
Coca cola
Milk
Orange

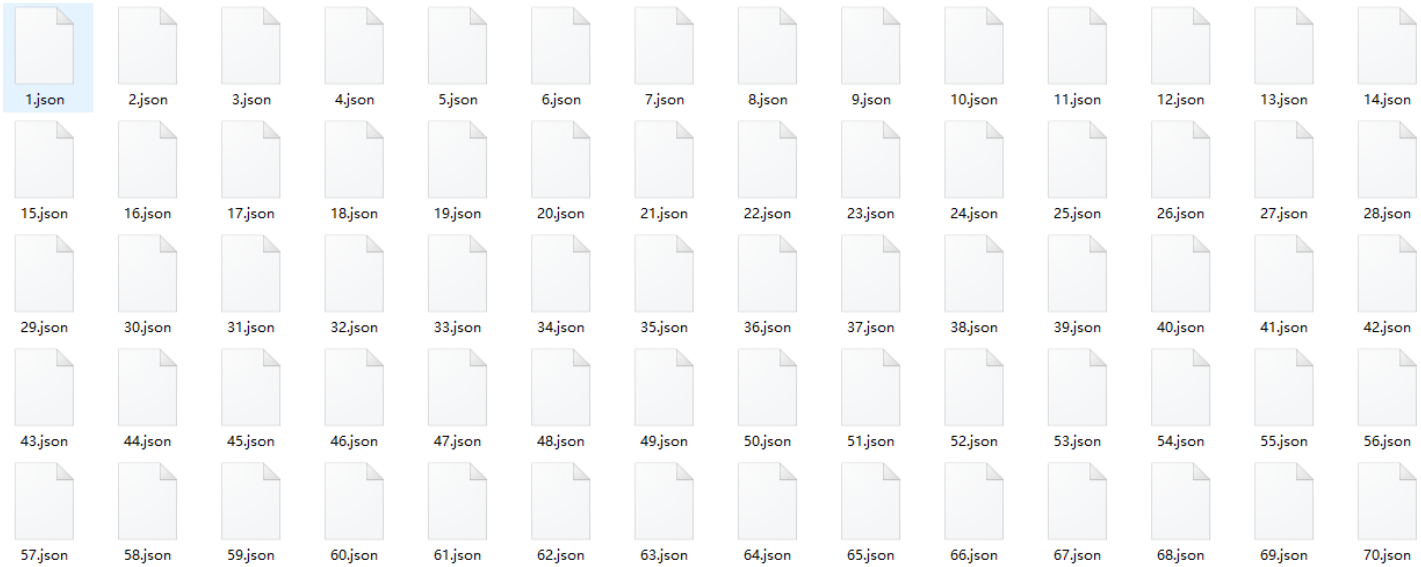
- **Collect 900 images**
- **Data Enhancement：**
  roate image 、increase exposoure、add noise
- **Final training data:**
  18000 images

Training data Collection

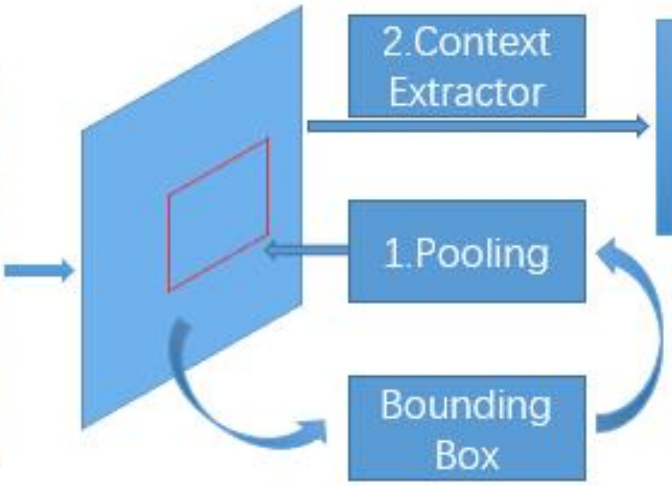


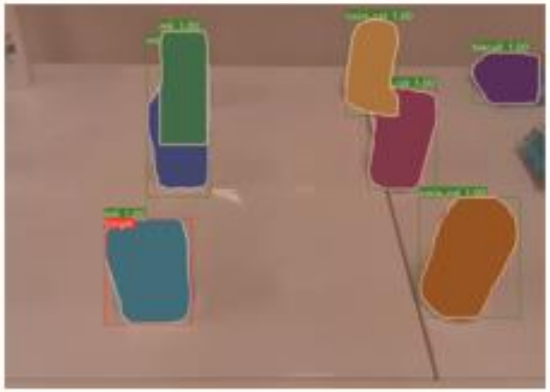
Training Data

Label Result



Object Detection result





Accuracy: 98%

Speed: 66 milliseconds

```
categories_output:[7]
mask_output length :1
Time for MaskRCNN: 66.9338703156ms
```

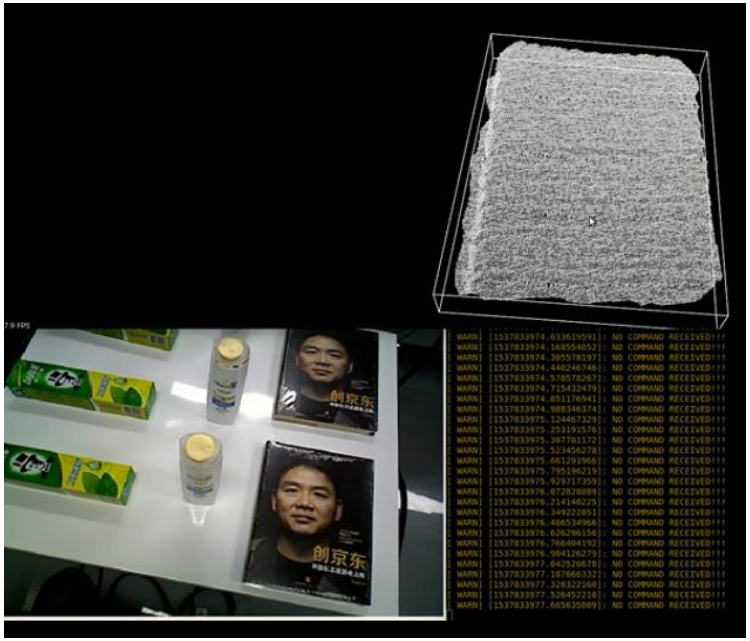
Pose Estimation

Pose Estimation

1) RGB-D image based Object Point Cloud generation
2) Point cloud down sampling and noise removing
3) Point cloud clustering
4) PCA pose estimation
5) Bounding Box Visualization

Pose Estimation

Bounding Box Visualization and estimated pose



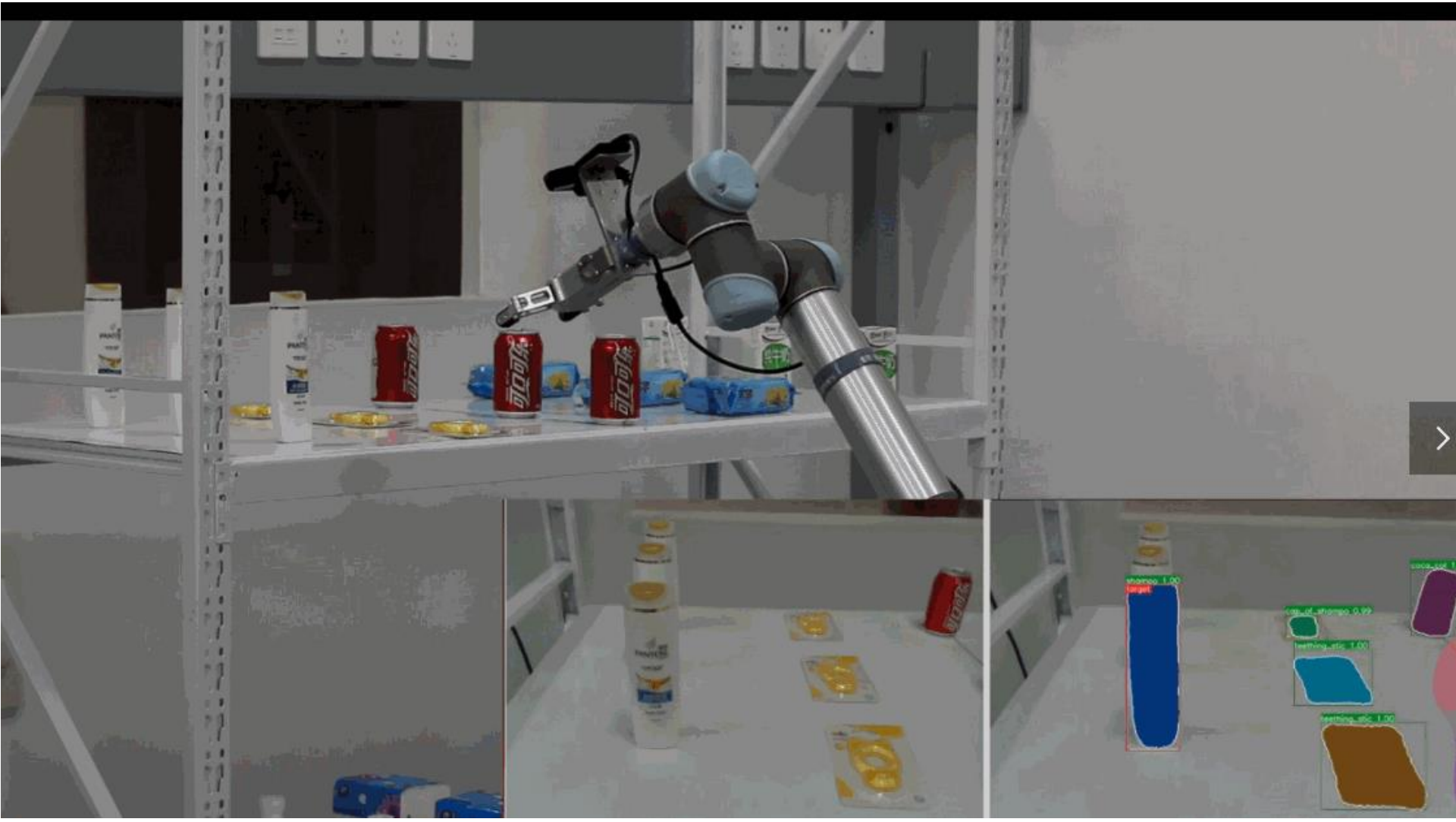
pose estimation result of **book**

pose estimation result of **shampoo**

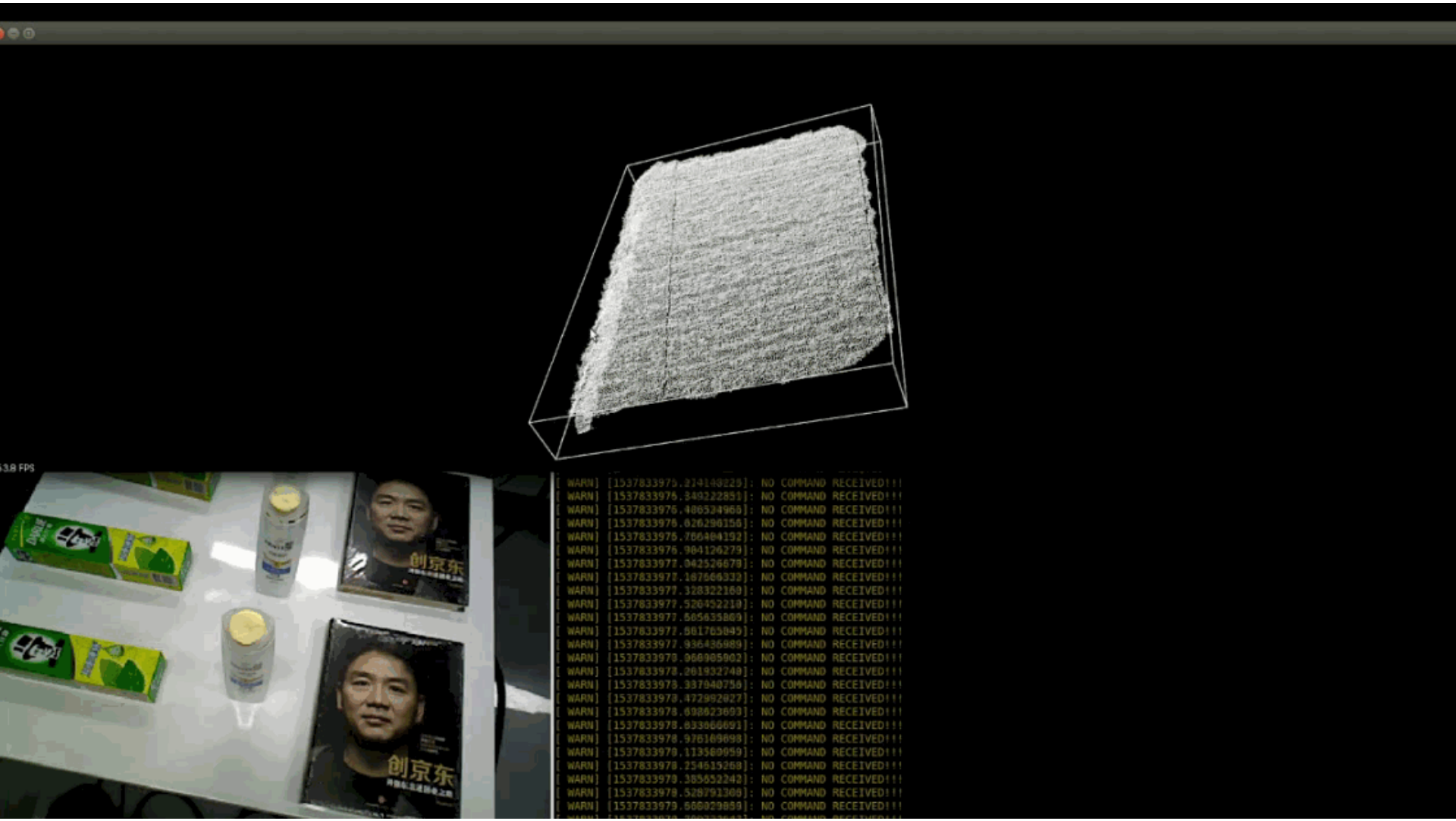
The Output:

- Center of the point cloud (x, y, z) Relative to the Robot end
- the long axis of the bounding box

Result of object detection



Result of pose estimation



Thanks