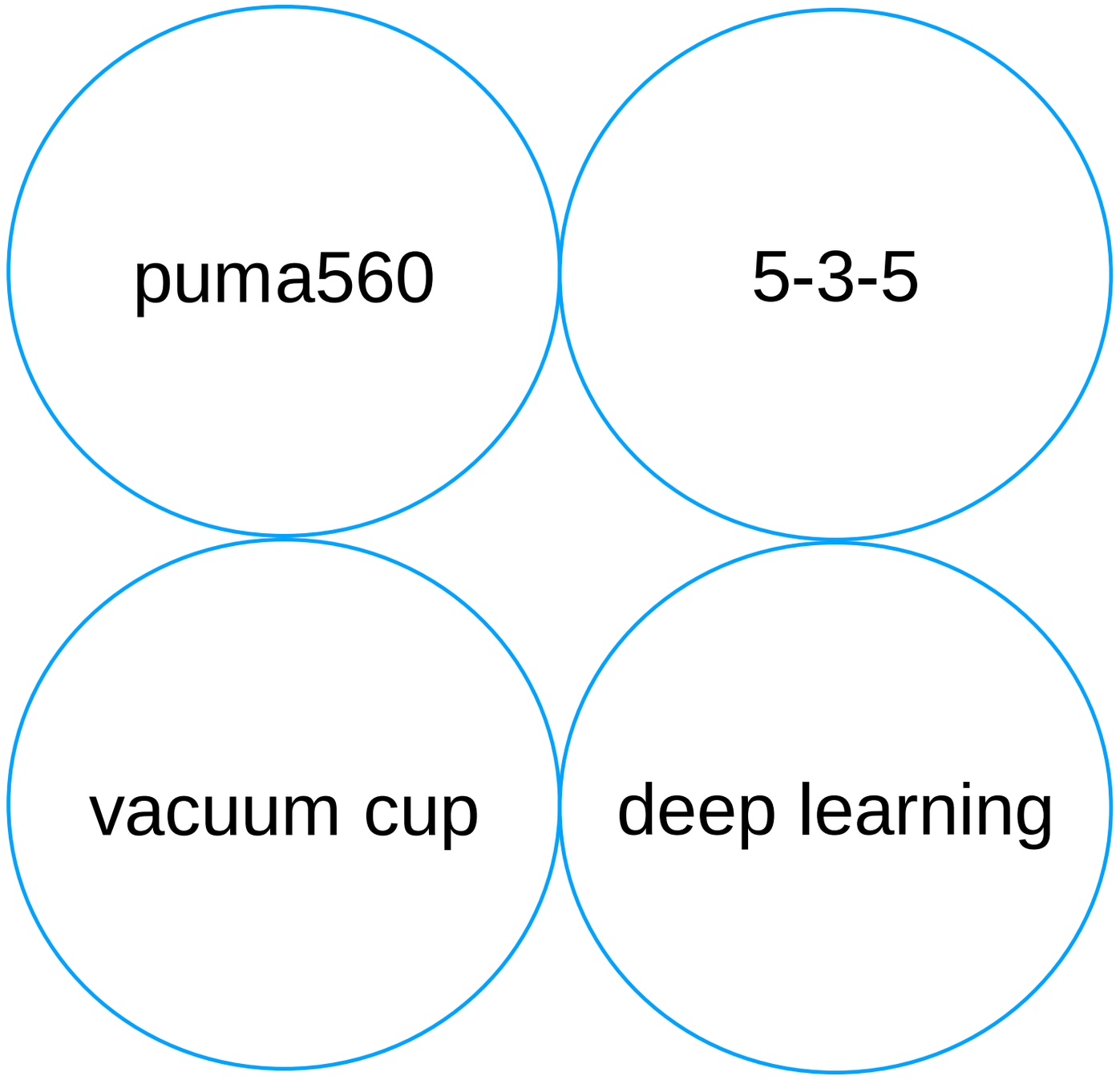
東南大學
SOUTHEAST UNIVERSITY

Design of Robot Sorting System for Soft Packaging Items

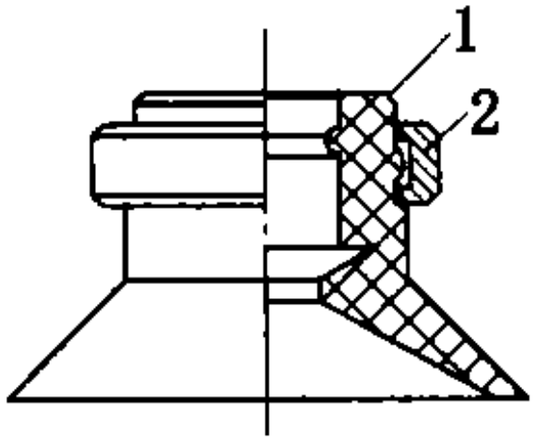
Catalog

- System module
- End effector
- Target detection
- System synergy
- Weakness

System module

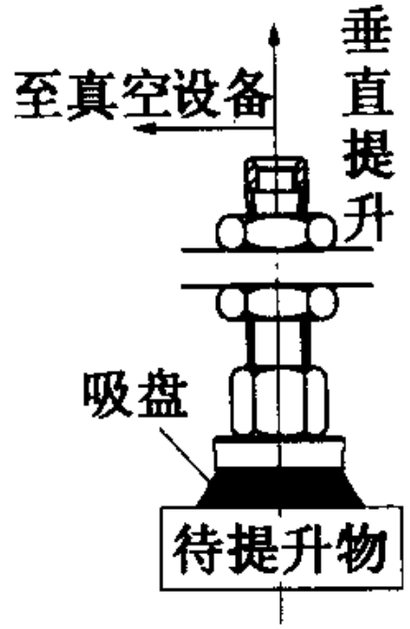


End effector



1.chuck 2.chuck hoop

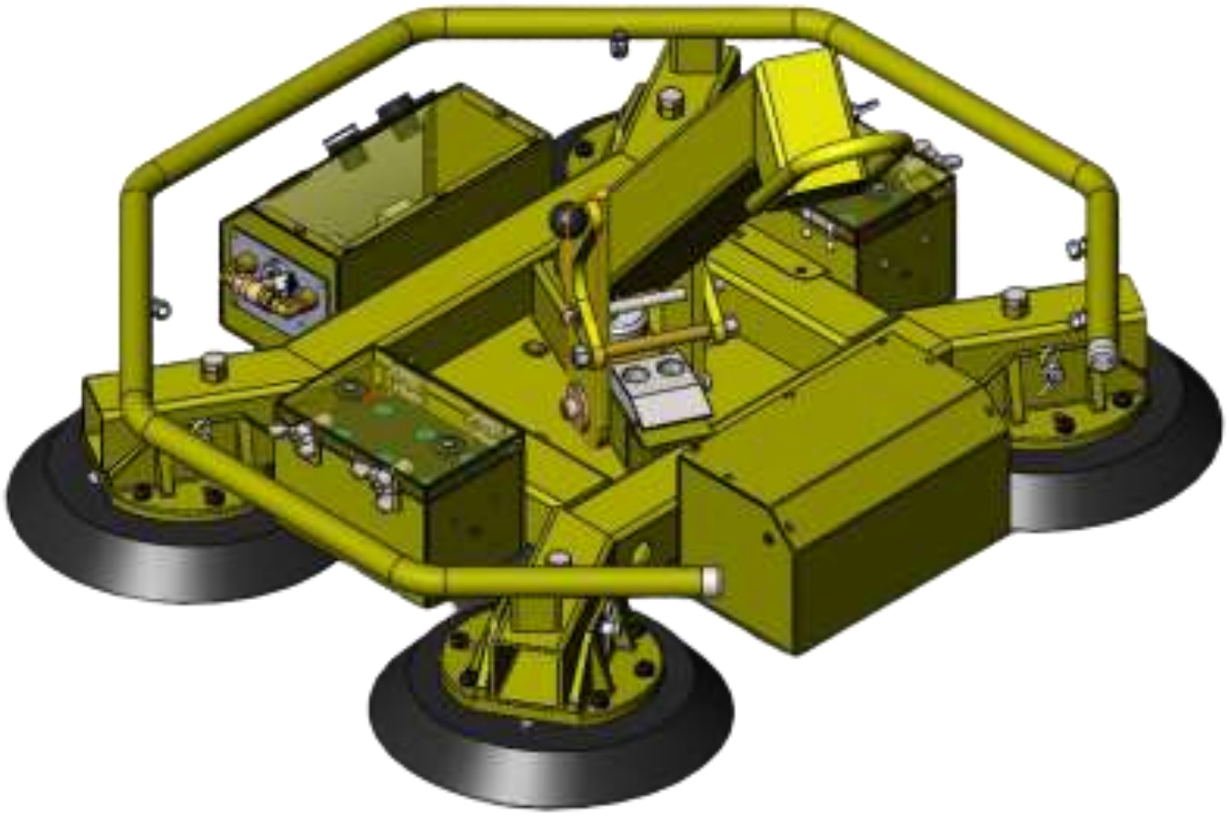
Structure



Principle

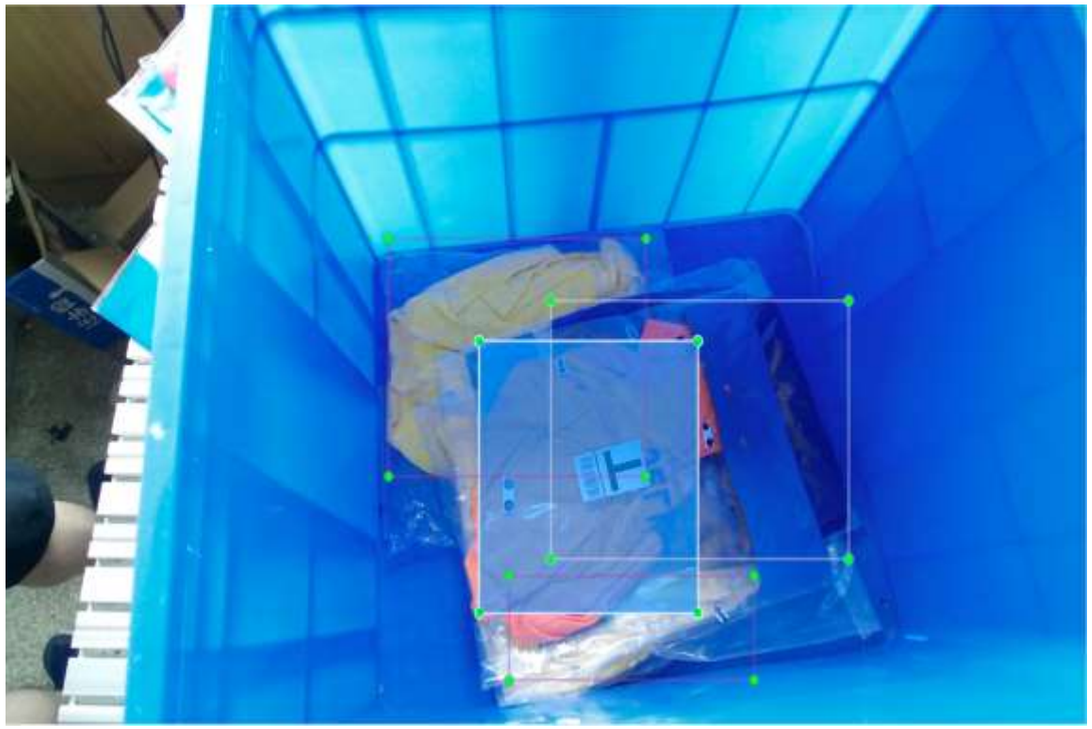
Connect -> Launch -> Suck up -> Blow up

Final scheme



Objection detection——Pipeline

- Annotation of raw data — LabelImg
- Data augmentation — DAOD package
- A standard format of dataset — VOC
- Training process — mmdetection--Faster-RCNN(Resnet101)
- Test and evaluation

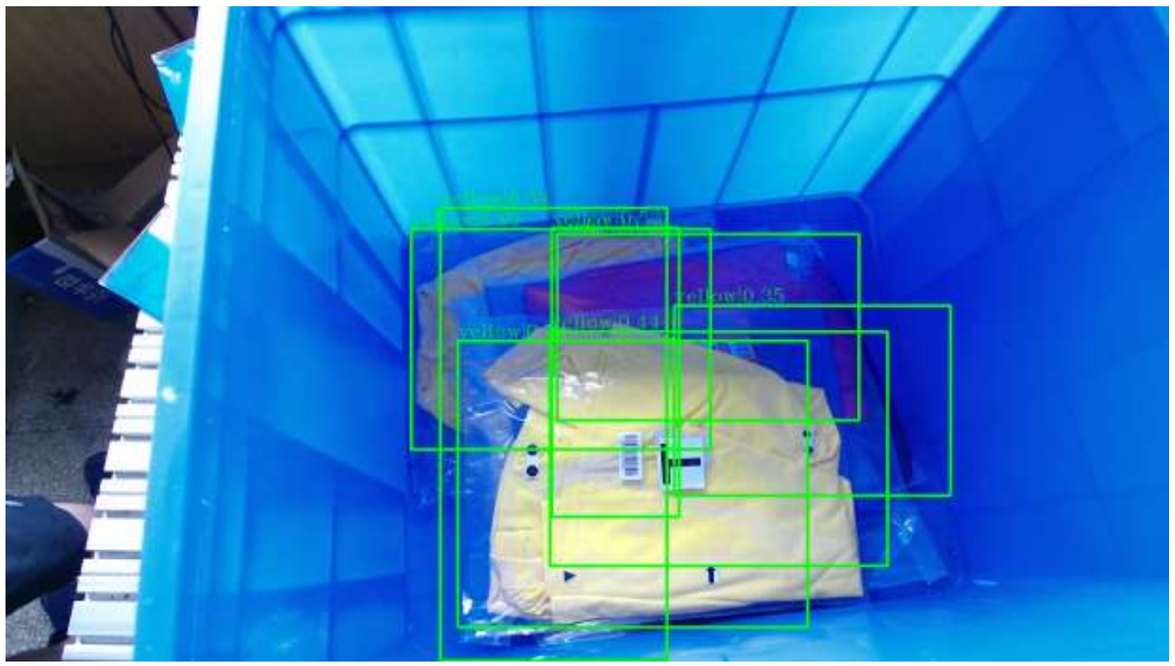


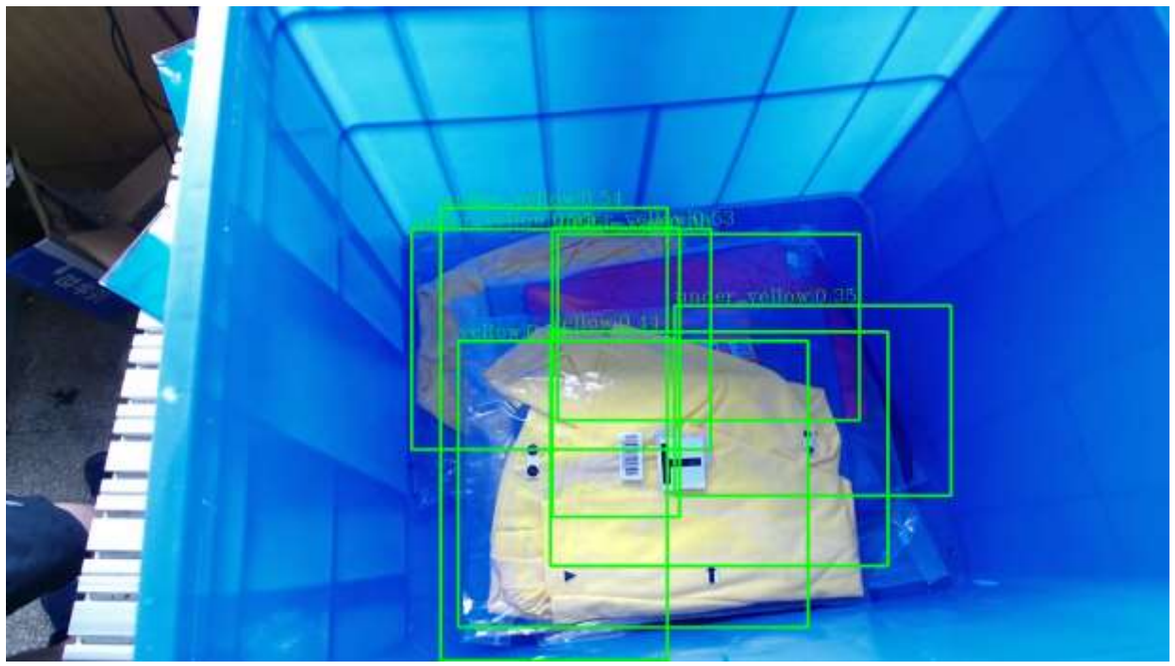
labelImg

mmdetection

Object detection--Data Annotations

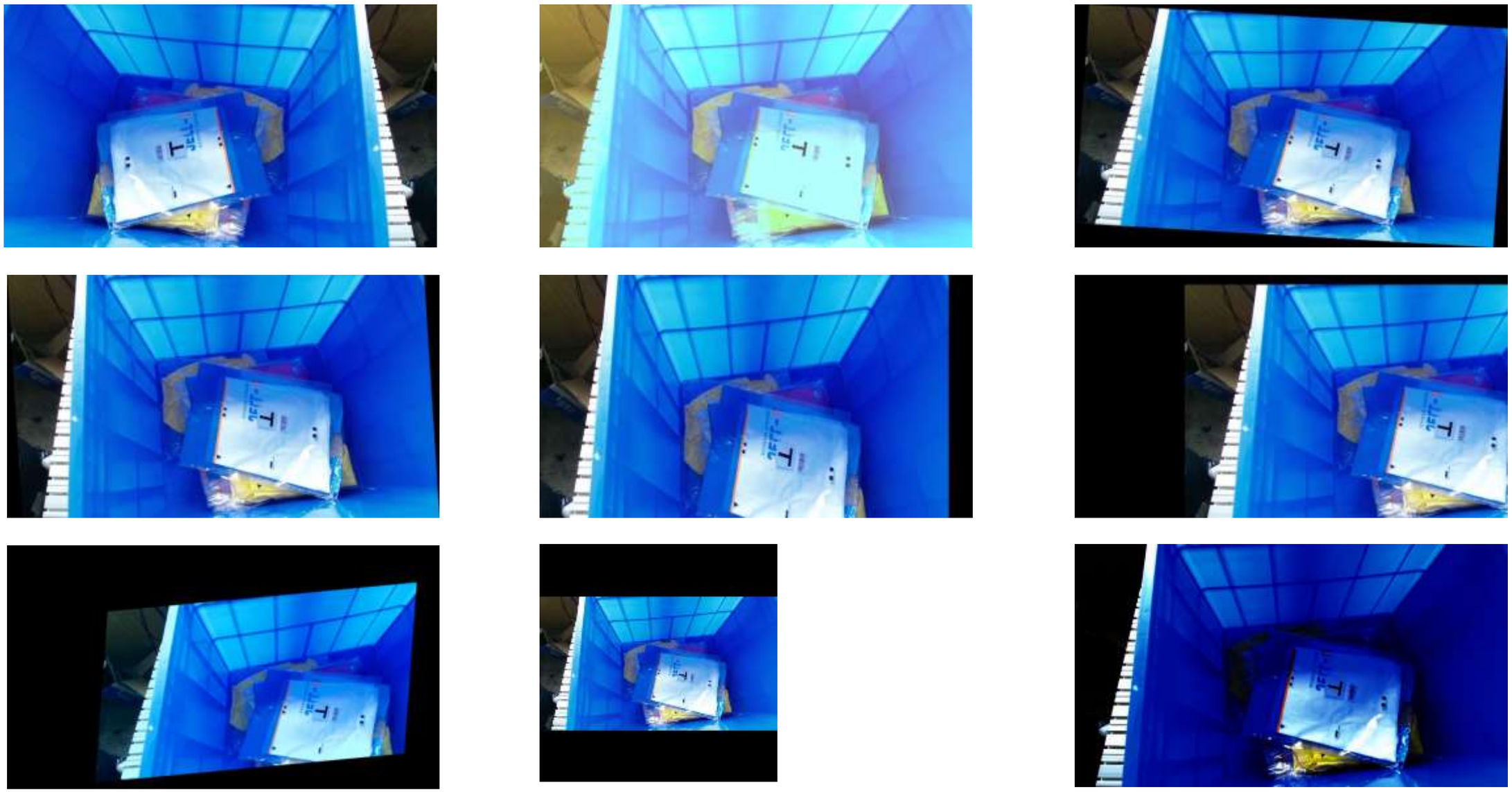
- VOC Format of datasets
- ‘under_color’ elements





Object detection--Data augmentation

- Datasets loading
- Data augmentation
- Corresponding Bounding Box & Parameters in .xml file
- An additional function to change the exposure value of images



Object Detection--Network

RCNN ⇒ fast-RCNN ⇒ faster-RCNN

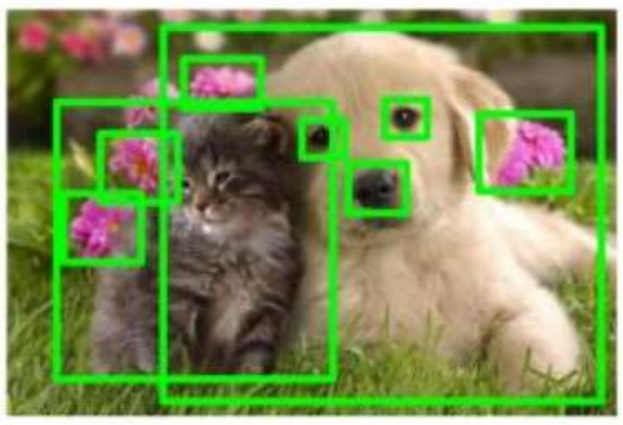
- Region Proposal
- Feature Extraction
- Classification
- Regression

⇒

- In: original image
- Mid: feature map
- Out: proposal

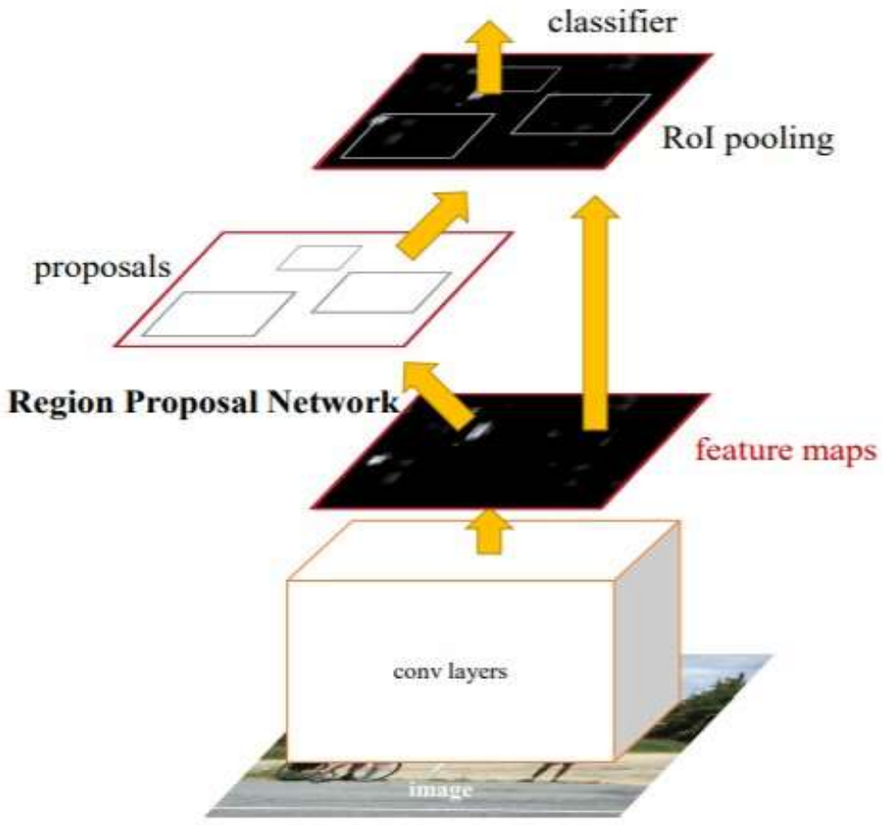
⇒

- RPN
- anchor- box



Backbone： Resnet101

Object Detection--Network

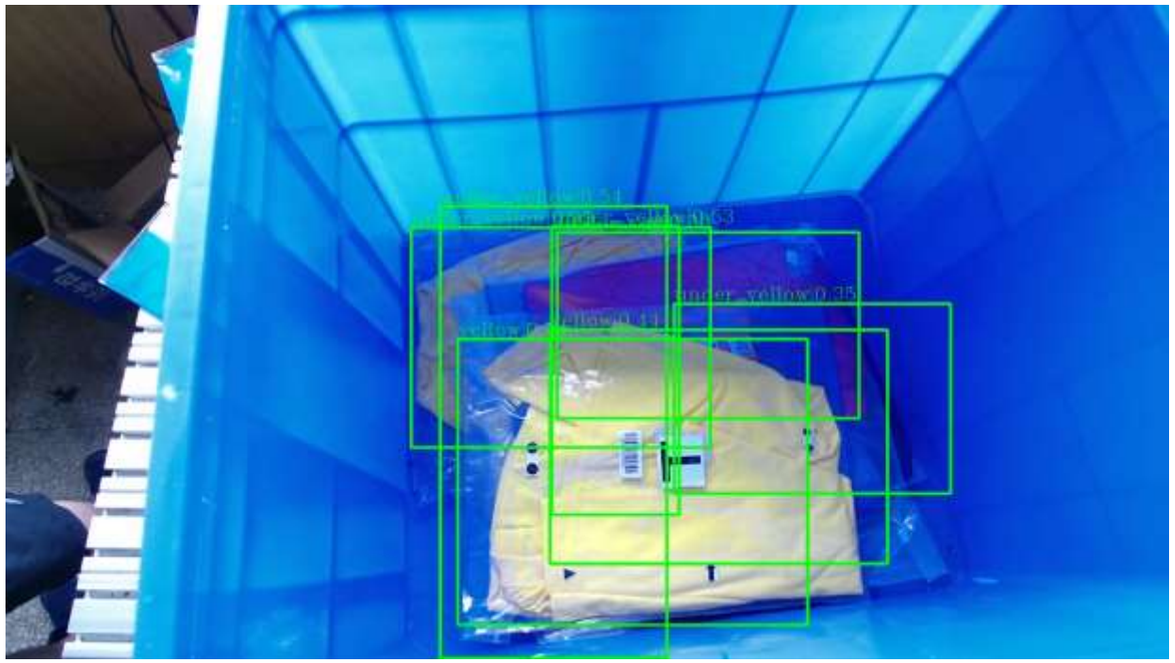


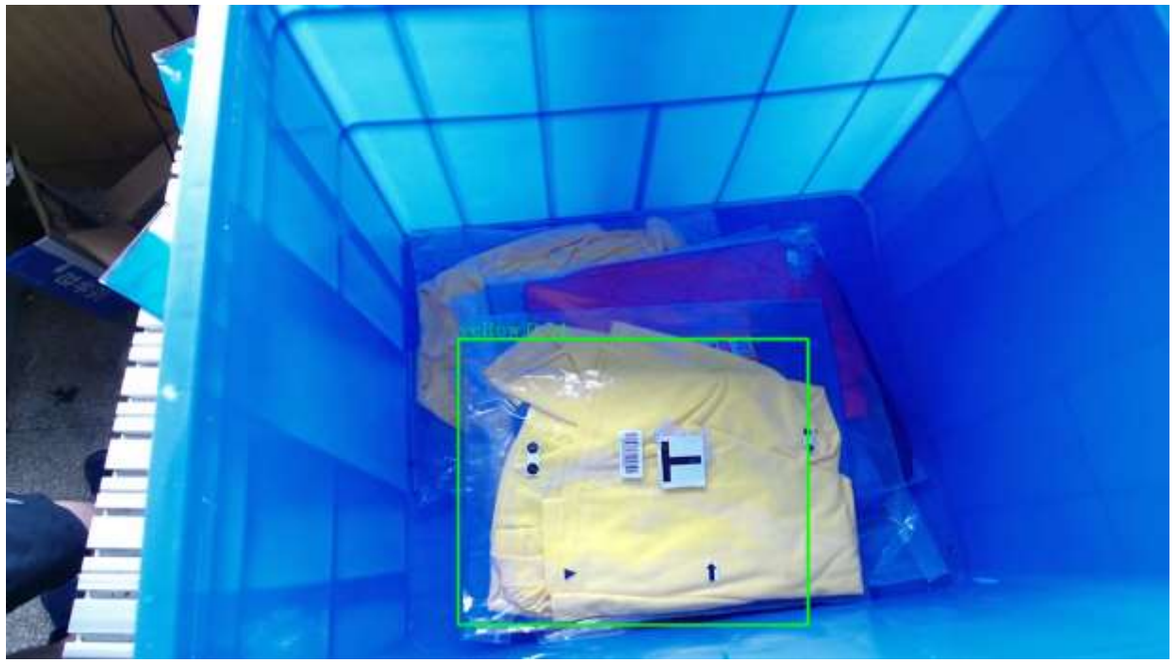
- Build sliding window on feature map
- Construct net for classification and regression
- Rough position provided by sliding window
- Regression of rect refines the position

	R-CNN	**Fast R-CNN**	**Faster R-CNN**
Test time per image (with proposals)	50 seconds	2 seconds	**0.2 seconds**
(Speedup)	1x	25x	**250x**
mAP (VOC 2007)	66.0	**66.9**	**66.9**

Object Detection--Output processing

- Filter - dump bounding boxes with under layer annotation
- NMS – keep only the bounding box with max confidence



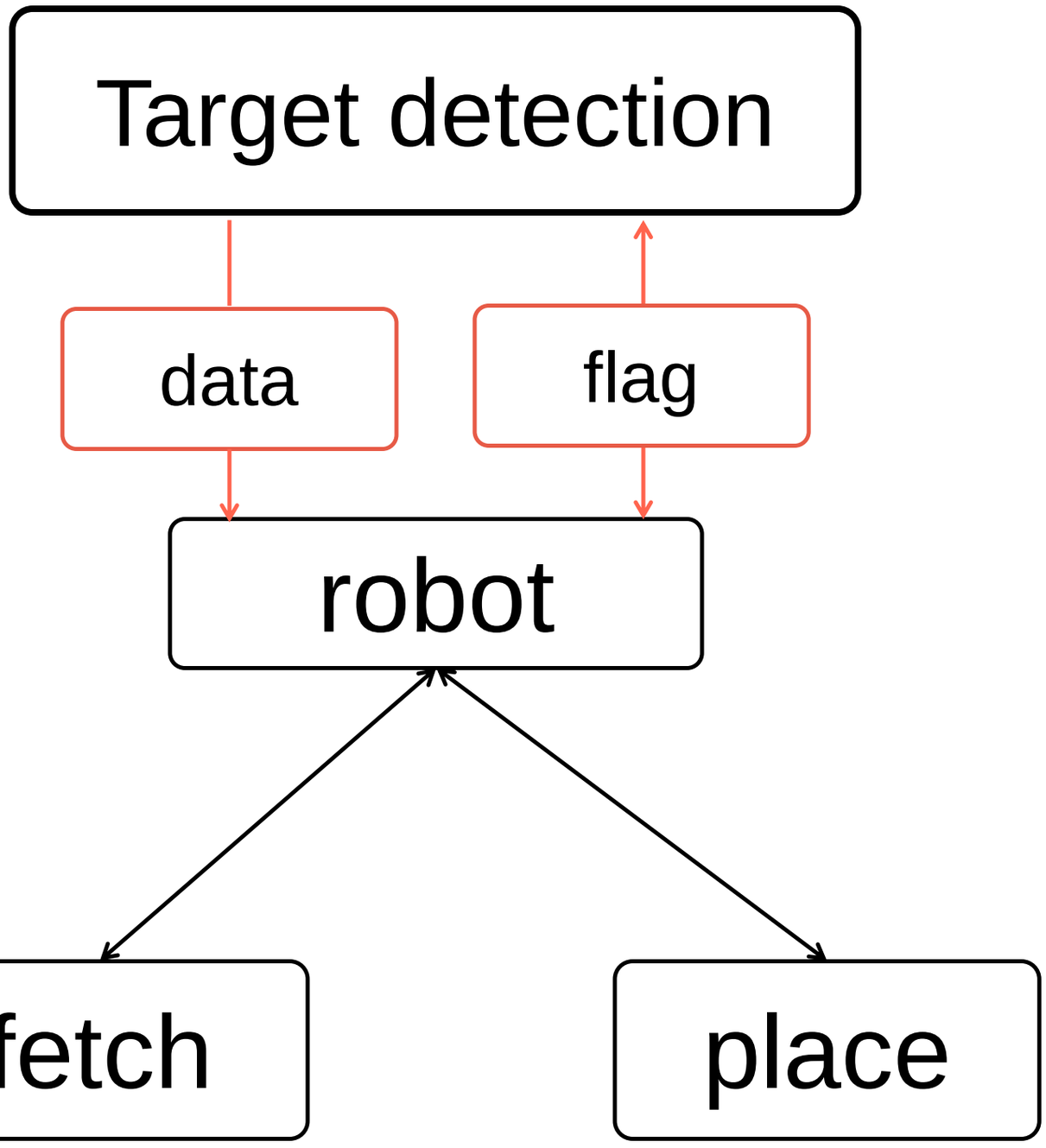


Object Detection--Evaluation

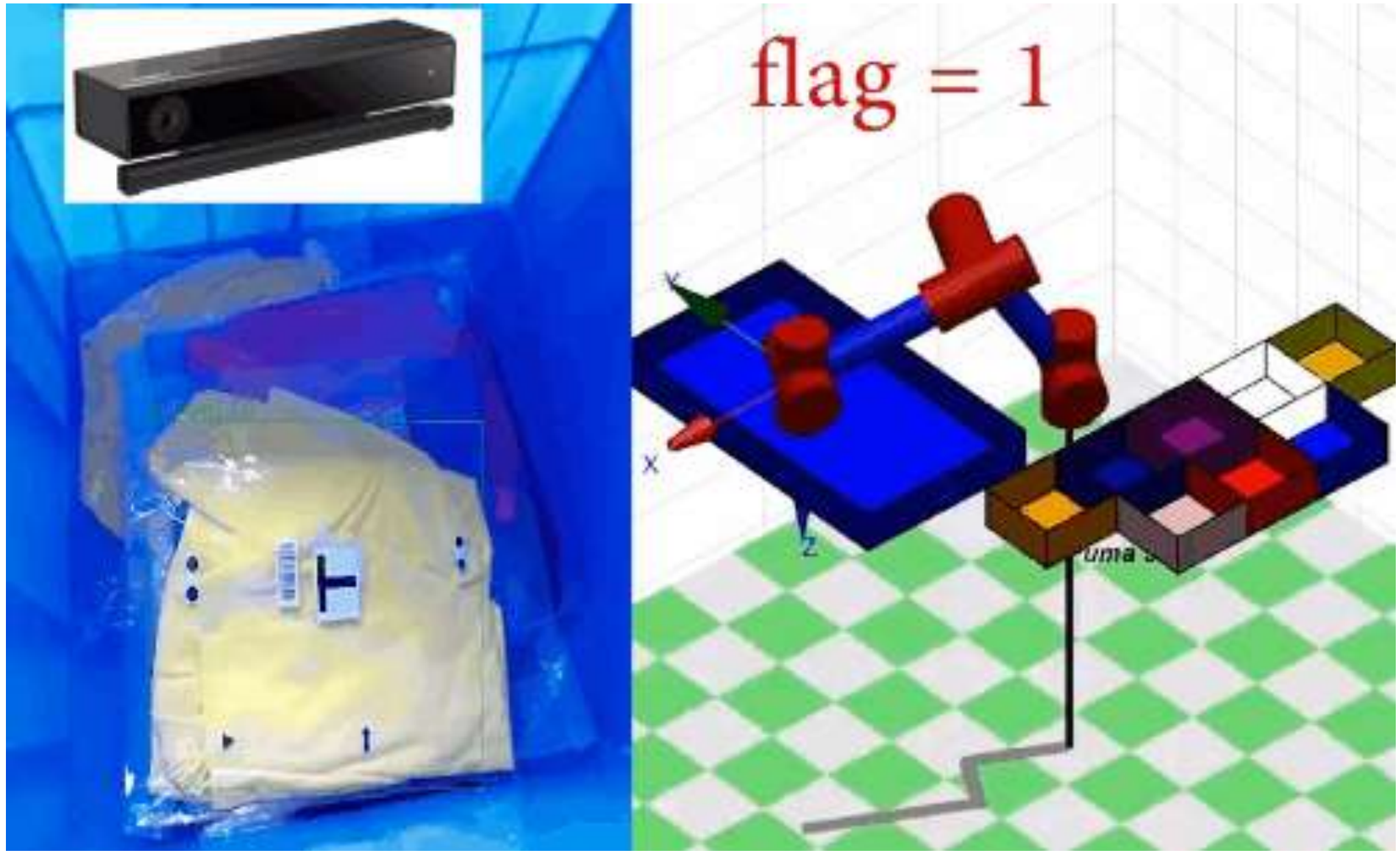
Color	Recall	Precision	Average IoU
white	66.67%	100.00%	60.59%
yellow	80.00%	80.00%	74.40%
blue	-	-	-
red	50.00%	25.00%	80.24%
pink	-	-	-
orange	71.43%	62.50%	67.28%
ultramarine	66.67%	80.00%	58.75%
purple	-	-	-

* Recall and Precision are calculated with IoU > 0.5

System synergy



System synergy



Weakness

- No angle detection
- No 3D simulation of arm and end effector