Garbage Sorting(Jetson-Nano)

1. Function Description

The garbage sorting function is based on the single garbage sorting function, adding the ability to recognize multiple garbage building blocks and sort multiple garbage building blocks.

Note:
1. Before starting the program, please follow the [Assembly and Installation Tutorial] -> [Installing the Map] tutorial to correctly install the map before proceeding.
2. This example runs on the host machine; simply open a web browser and enter the IP address:8888

The robotic arm position calibration file is saved at ~/dofbot_ws/src/dofbot_garbage_yolov5/XYT_config.txt.

2. Code Block Design

- Import header files

```
import cv2 as cv
import threading
from time import sleep
import ipywidgets as widgets
from IPython.display import display
from identify_target import identify_GetTarget
from dofbot_utils.dofbot_config import *
from dofbot_utils.fps import FPS
```

- Create instances, initialize parameters

```
target = identify_GetTarget()
calibration = Arm_Calibration()
num = 0
dp = []
xy = [90, 106]
msg = {}
threshold = 116
debug_pos = False
model = "General"
color_list = {'1': 'red', '2': 'green', '3': 'blue', '4': 'yellow'}
color_hsv  = {"red"   : ((0, 43, 46), (10, 255, 255)),
              "green" : ((35, 43, 46), (77, 255, 255)),
              "blue"  : ((100, 43, 46), (124, 255, 255)),
              "yellow": ((26, 43, 46), (34, 255, 255))}
HSV_path="/home/jetson/dofbot_ws/src/dofbot_color_identify/scripts/HSV_config.tx
t"
# XYT Parameter path
XYT_path="/home/jetson/dofbot_ws/src/dofbot_color_sorting/scripts/XYT_config.txt
"
try: read_HSV(HSV_path,color_hsv)
```

```
except Exception: print("Read HSV_config Error !!!")
try: xy, threshold = read_XYT(XYT_path)
except Exception: print("Read XYT_config Error !!!")
```

```
import Arm_Lib
arm = Arm_Lib.Arm_Device()
joints_0 = [xy[0], xy[1], 0, 0, 90, 30]
arm.Arm_serial_servo_write6_array(joints_0, 1000)
fps = FPS()
```

- Create widgets

```
button_layout      = widgets.Layout(width='320px', height='60px',
align_self='center')
output = widgets.Output()
# Adjust the slider
joint1_slider      = widgets.IntSlider(description='joint1 :'    ,    value=xy[0]
    , min=70 , max=110, step=1, orientation='horizontal')
joint2_slider      = widgets.IntSlider(description='joint2 :'    ,    value=xy[1]
    , min=90, max=150, step=1, orientation='horizontal')
threshold_slider   = widgets.IntSlider(description='threshold :',
value=threshold , min=0  , max=255, step=1, orientation='horizontal')

# Enter calibration mode
calibration_model  = widgets.Button(description='calibration_model',
button_style='primary', layout=button_layout)
calibration_ok     = widgets.Button(description='calibration_ok',
button_style='success', layout=button_layout)
calibration_cancel = widgets.Button(description='calibration_cancel',
button_style='danger', layout=button_layout)
# Select grab color
color_list_one     = widgets.Dropdown(options=['red', 'green', 'blue', 'yellow',
'none'], value='red', disabled=False)
color_list_two     = widgets.Dropdown(options=['red', 'green', 'blue', 'yellow',
'none'], value='green', disabled=False)
color_list_three   = widgets.Dropdown(options=['red', 'green', 'blue', 'yellow',
'none'], value='blue', disabled=False)
color_list_four    = widgets.Dropdown(options=['red', 'green', 'blue', 'yellow',
'none'], value='yellow', disabled=False)
# Target detection and capture
target_detection   = widgets.Button(description='target_detection',
button_style='info', layout=button_layout)
reset_color_list   = widgets.Button(description='reset_color_list',
button_style='info', layout=button_layout)
grap = widgets.Button(description='grap', button_style='success',
layout=button_layout)
# exit
exit_button = widgets.Button(description='Exit', button_style='danger',
layout=button_layout)
imgbox = widgets.Image(format='jpg', height=480, width=640,
layout=widgets.Layout(align_self='center'))
color_down = widgets.HBox([exit_button, reset_color_list],
layout=widgets.Layout(align_self='center'));
color_img = widgets.VBox([imgbox, color_down],
layout=widgets.Layout(align_self='center'));
color_identify = widgets.VBox(
    [joint1_slider, joint2_slider, threshold_slider, calibration_model,
calibration_ok, calibration_cancel,
     color_list_one, color_list_two, color_list_three, color_list_four,
target_detection, grap],
    layout=widgets.Layout(align_self='center'));
controls_box = widgets.HBox([color_img, color_identify],
layout=widgets.Layout(align_self='center'))
```

- Calibration callback

```
def calibration_model_Callback(value):
    global model
    model = 'Calibration'
    with output: print(model)
def calibration_OK_Callback(value):
    global model
    model = 'calibration_OK'
    with output: print(model)
def calibration_cancel_Callback(value):
    global model
    model = 'calibration_Cancel'
    with output: print(model)
calibration_model.on_click(calibration_model_Callback)
calibration_ok.on_click(calibration_OK_Callback)
calibration_cancel.on_click(calibration_cancel_Callback)
```

- Color selection sequence

```
# Select color
def color_list_one_Callback(value):
    global model,color_list
    model="General"
    if not isinstance(value['new'],str):return
    if value['new'] == "none":
        if '1' in color_list:del color_list['1']
    elif value['new'] == "red":
        color_list['1'] = "red"
    elif value['new']== "green":
        color_list['1'] = "green"
    elif value['new'] == "blue":
        color_list['1'] = "blue"
    elif value['new'] == "yellow":
        color_list['1'] = "yellow"
    with output:
        print("color_list_three_Callback clicked.",color_list)
def color_list_two_Callback(value):
    global model,color_list
    model="General"
    if not isinstance(value['new'],str):return
    if value['new'] == "none":
        if '2' in color_list:del color_list['2']
    elif value['new'] == "red":
        color_list['2'] = "red"
    elif value['new'] == "green":
        color_list['2'] = "green"
    elif value['new'] == "blue":
        color_list['2'] = "blue"
    elif value['new'] == "yellow":
        color_list['2'] = "yellow"
    with output:
        print("color_list_three_Callback clicked.",color_list)
def color_list_three_Callback(value):
    global model,color_list
    model="General"
    if not isinstance(value['new'],str):return
    if value['new'] == "none":
        if '3' in color_list:del color_list['3']
    elif value['new'] == "red":
        color_list['3'] = "red"
    elif value['new'] == "green":
        color_list['3'] = "green"
    elif value['new'] == "blue":
        color_list['3'] = "blue"
    elif value['new'] == "yellow":
        color_list['3'] = "yellow"
    with output:
        print("color_list_three_Callback clicked.",color_list)
def color_list_four_Callback(value):
    global model,color_list
    model="General"
    if not isinstance(value['new'],str):return
    if value['new'] == "none":
        if '4' in color_list:del color_list['4']
    elif value['new'] == "red":
        color_list['4'] = "red"
    elif value['new'] == "green":
        color_list['4'] = "green"
    elif value['new'] == "blue":
        color_list['4'] = "blue"
    elif value['new'] == "yellow":
        color_list['4'] = "yellow"
    with output:
        print("color_list_four_Callback clicked.",color_list)
color_list_one.observe(color_list_one_Callback)
color_list_two.observe(color_list_two_Callback)
color_list_three.observe(color_list_three_Callback)
color_list_four.observe(color_list_four_Callback)
```

- Mode switching

```
def target_detection_Callback(value):
    global model, debug_pos
    model = 'Detection'
    debug_pos = True
    with output: print(model)
def reset_color_list_Callback(value):
    global model
    model = 'Reset_list'
    with output: print(model)
def grap_Callback(value):
    global model
    model = 'Grap'
    with output: print(model)
```

```
def exit_button_Callback(value):
    global model
    model = 'Exit'
    with output: print(model)
target_detection.on_click(target_detection_Callback)
reset_color_list.on_click(reset_color_list_Callback)
grap.on_click(grap_Callback)
exit_button.on_click(exit_button_Callback)
```

- Main program

```
def camera():
    global color_hsv,model,dp,msg,color_list,debug_pos
    # Open camera
    capture = cv.VideoCapture(0)
    capture.set(cv.CAP_PROP_FRAME_WIDTH, 640)
    capture.set(cv.CAP_PROP_FRAME_HEIGHT, 480)
    index=1
    # Be executed in loop when the camera is opened normally
    while capture.isOpened():
        try:
            _, img = capture.read()
            fps.update_fps()
            xy=[joint1_slider.value,joint2_slider.value]
            if model == 'Calibration':
                _, img =
calibration.calibration_map(img,xy,threshold_slider.value)
            if model == 'calibration_OK':
                try: write_XYT(XYT_path,xy, threshold_slider.value)
                except Exception: print("File XYT_config Error !!!")
                dp, img =
calibration.calibration_map(img,xy,threshold_slider.value)
                model="General"
            if len(dp) != 0: img = calibration.Perspective_transform(dp, img)
            if model == 'calibration_Cancel':
                dp = []
                msg= {}
                model="General"
            if len(dp)!= 0 and len(color_list)!= 0 and model == 'Detection':
                img, msg = target.select_color(img, color_hsv, color_list)
                # print("Detection msg:", msg)
                if debug_pos:
                    debug_pos = False
                    print("detect msg:", msg)
            if model=="Reset_list":
                msg={}
                color_list = {}
                color_list_one.value = 'none'
                color_list_two.value = 'none'
                color_list_three.value = 'none'
                color_list_four.value = 'none'
                model="General"
            if len(msg)!= 0 and model == 'Grap':
                print("grasp msg:", msg)
                threading.Thread(target=target.target_run, args=
(msg,xy)).start()
                msg={}
                model="Detection"
            if model == 'Exit':
                capture.release()
                break
            index+=1
            fps.show_fps(img)
            imgbox.value = cv.imencode('.jpg', img)[1].tobytes()
        except KeyboardInterrupt:capture.release()
```

- Startup

```
display(controls_box,output)
threading.Thread(target=camera, ).start()
```

3. Start the Program

Start ROS Node Service

Open the system terminal and enter the following command. If it's already running, there's no need to start it again.

```
sudo systemctl start yahboom_arm.service
```

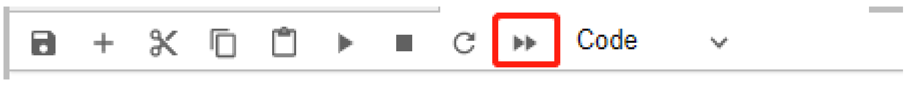
Start the Program

Open the jupyterlab webpage and find the corresponding .ipynb program file.

Code path:

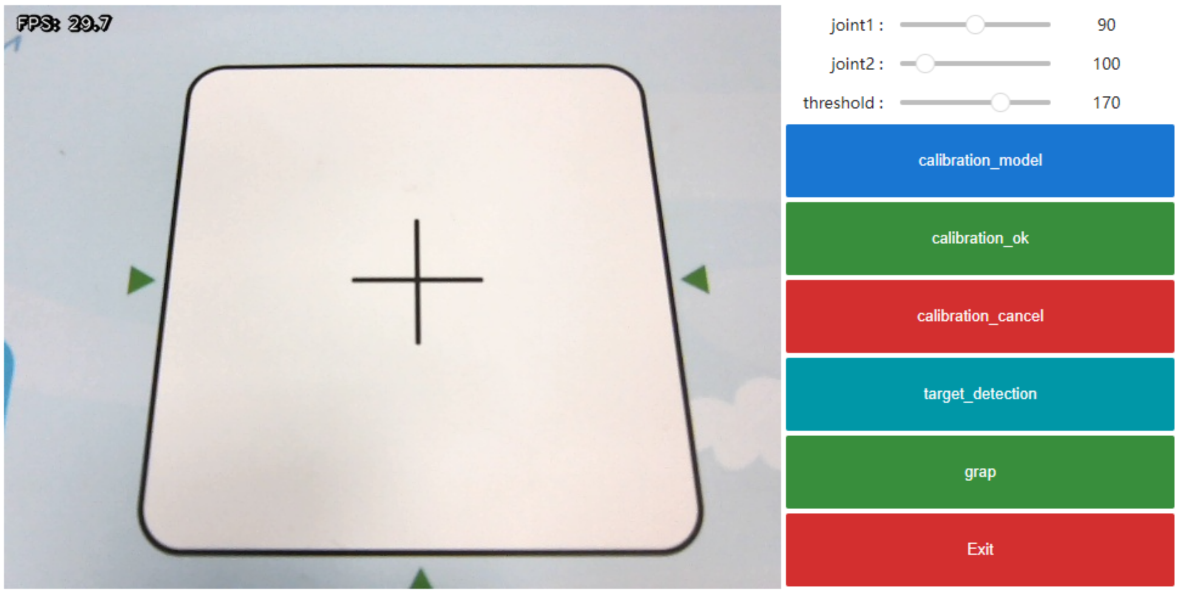
```
~/dofbot_ws/src/dofbot_garbage_yolov5/Garbage_Sorting.ipynb
```

Then click the run all command.

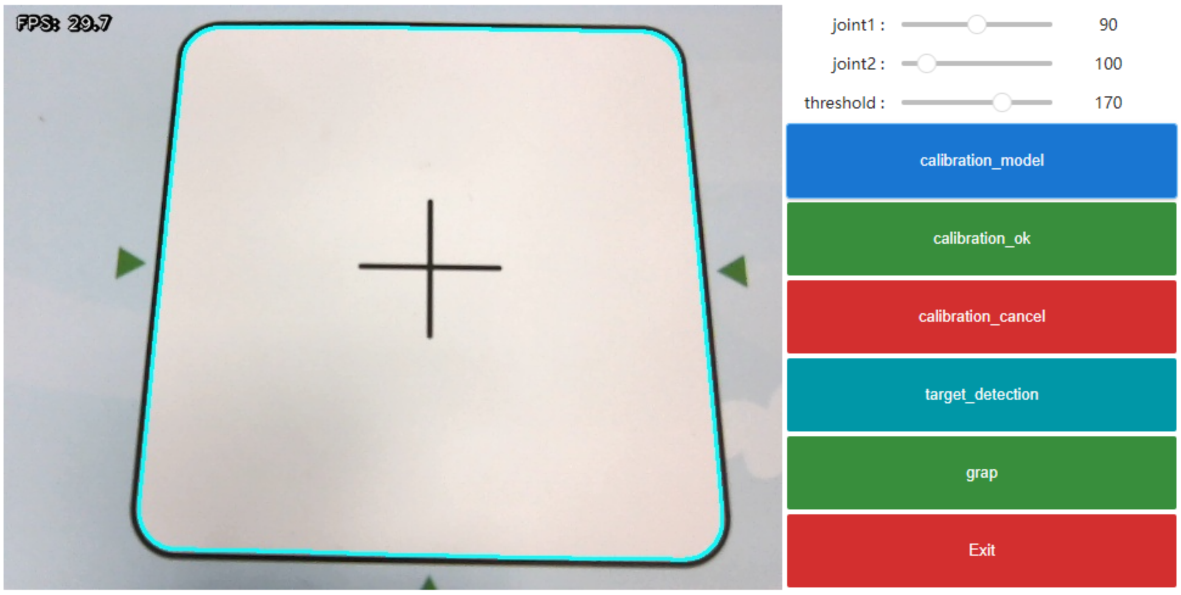


4. Experimental Effects

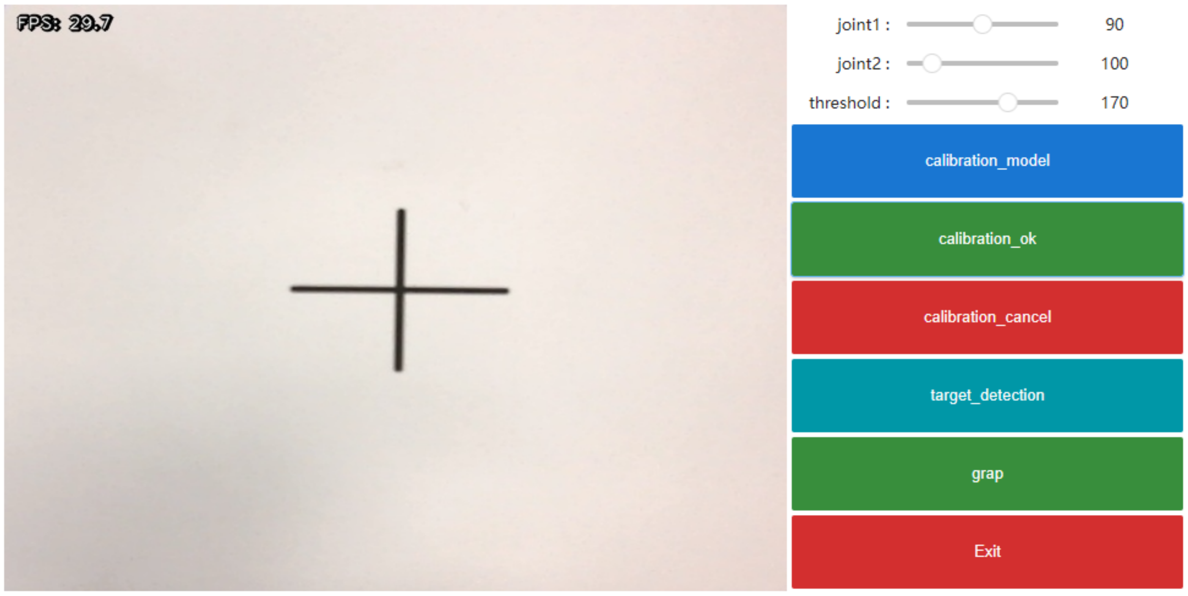
After the program runs, the jupyterlab webpage will display controls, with the camera display on the left and related button functions on the right.



Click [calibration_model] to enter calibration mode. Adjust the robotic arm joint sliders and threshold slider above to make the displayed blue line overlap with the black line of the recognition area.

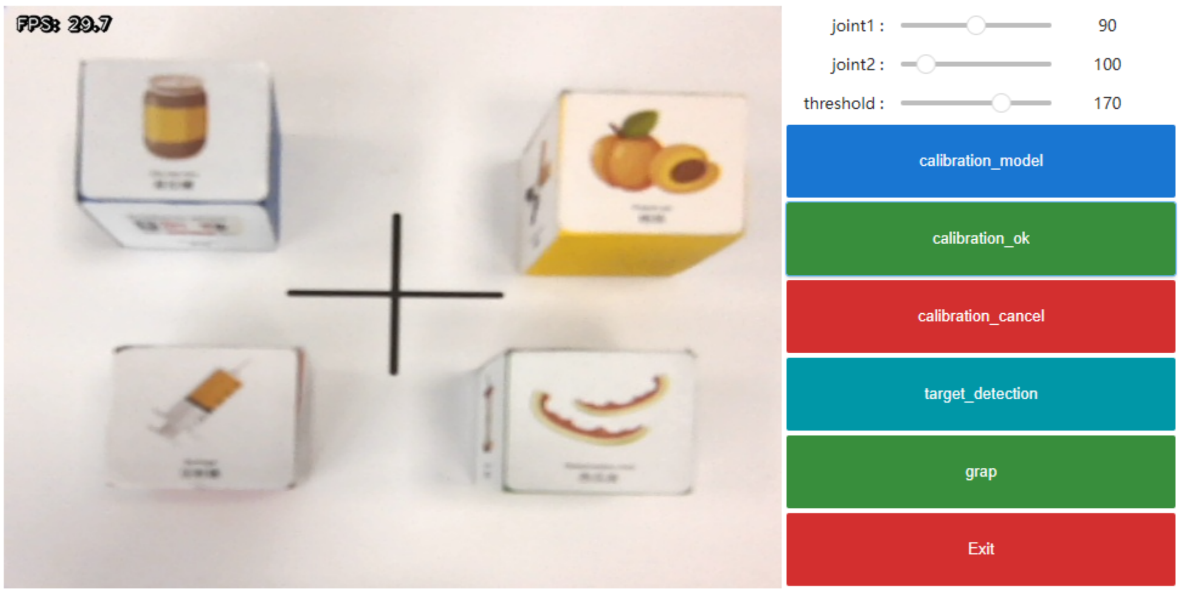


Then click [calibration_ok] for calibration OK. At this time, the camera view switches to the recognition area perspective.

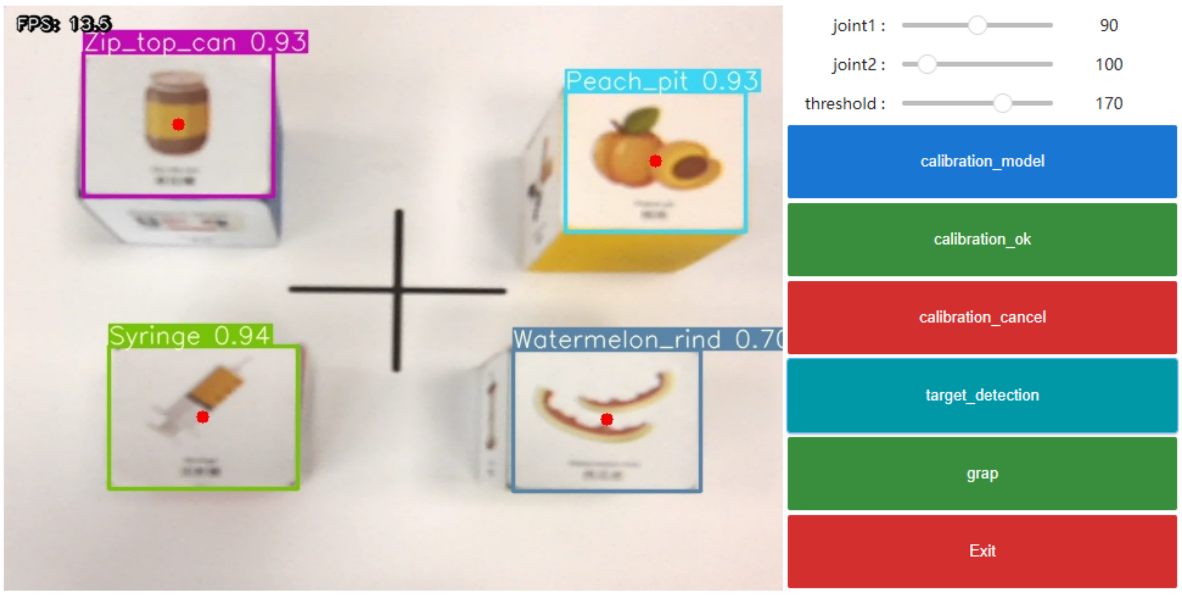


Place the building blocks in the recognition area with the garbage sticker side facing up, keeping the text direction consistent with the camera direction, and try to keep the bottom edge parallel to the bottom edge of the recognition area.

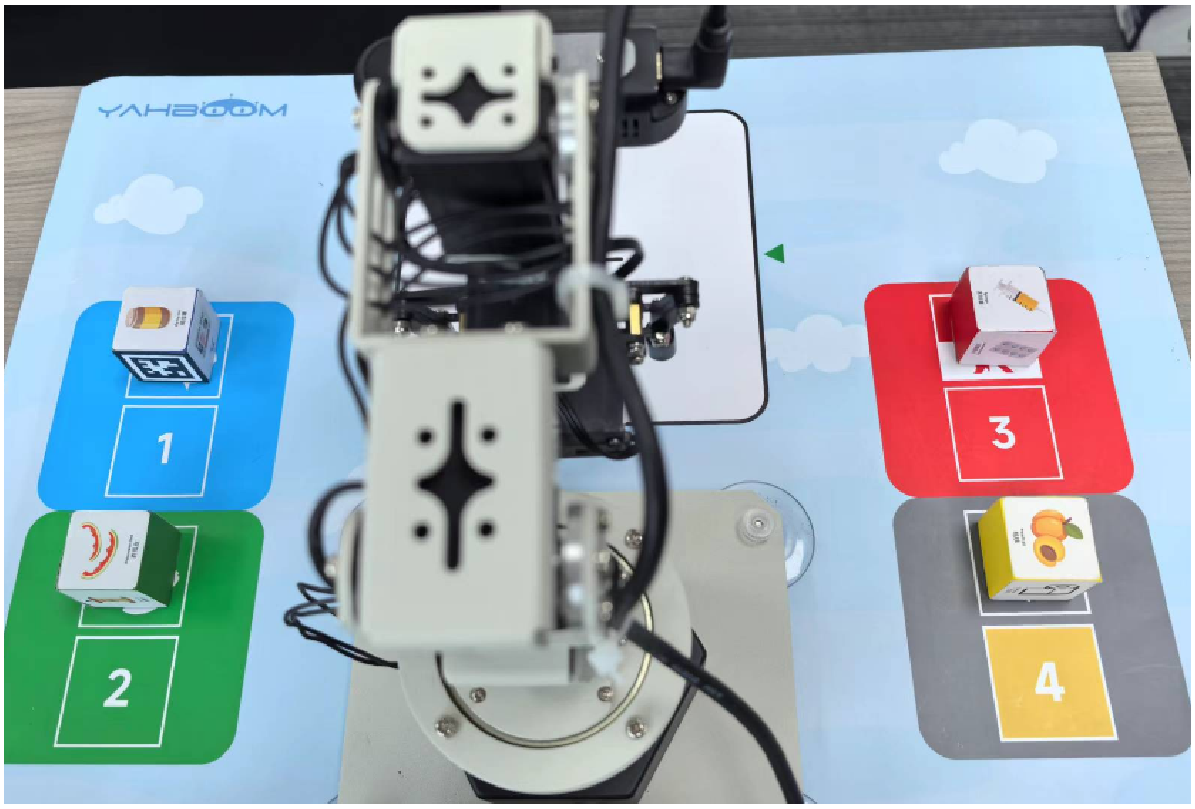
Note: Due to the height of the building blocks, try to place them in the central area when placing, otherwise the camera may not capture the complete garbage sticker, making correct recognition impossible.



Then click [target_detection] to start color recognition. If color recognition is not accurate, please calibrate the colors first and then restart the program.

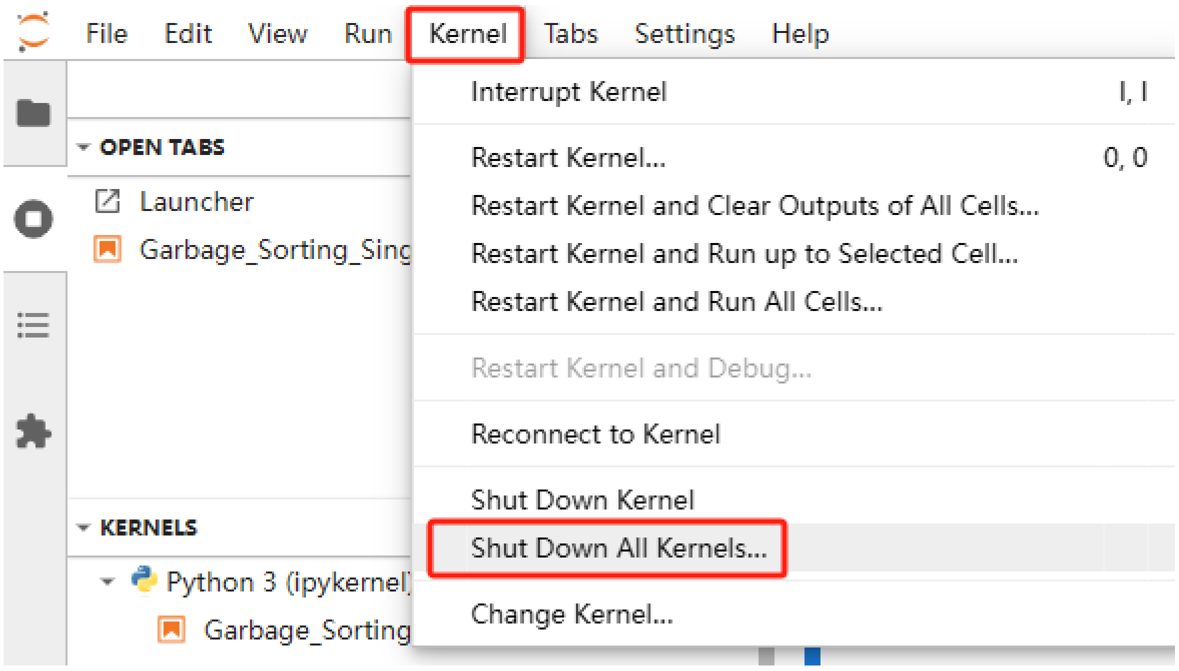


Then click the [grap] button to start sorting. The system will sort the recognized garbage sequentially into the corresponding garbage category areas.



If you need to exit the program, please click the [Exit] button.

Since garbage recognition requires loading model files and occupies a large amount of memory space, [Exit] only ends the functionality and does not close the model file-related programs. You need to close the current kernels to close the model file programs. Click [Kernel] -> [Shut Down All Kernels] in the menu bar sequentially.


File
Edit
View
Run
Kernel
Tabs
Settings
Help
OPEN TABS
Launcher
Garbage_Sorting_Sing
KERNELS
Python 3 (ipykernel)
Garbage_Sorting
Interrupt Kernel I, I
Restart Kernel... 0, 0
Restart Kernel and Clear Outputs of All Cells...
Restart Kernel and Run up to Selected Cell...
Restart Kernel and Run All Cells...
Restart Kernel and Debug...
Reconnect to Kernel
Shut Down Kernel
Shut Down All Kernels...
Change Kernel...