Tag code stacking

1. Functional description

The tag code stacking function is based on tag code sorting, and the position of the clamping placement is modified to the way of stacking building blocks. The functional operation is similar.

Note: Before starting the program, please follow the [Assembly and Assembly Tutorial] -> [Install Map] tutorial, and install the map correctly before operating.

The path for saving the file of the robot arm position calibration is ~/dofbot_pro/dofbot_apriltag/scripts/XYT_config.txt.

Code path:

```
~/dofbot_pro/dofbot_apriltag/scripts/Apriltag_Stacking.ipynb
```

2. Code block design

- Import header files

```
import cv2 as cv
import threading
import time
import ipywidgets as widgets
from IPython.display import display

from apriltag_identify import ApriltagIdentify
from apriltag_grasp import Apriltag_Grasp
from dofbot_utils.fps import FPS
from dofbot_utils.dofbot_config import *
```

- Create an instance and initialize parameters

```
apriltag_Identify = ApriltagIdentify()
target = Apriltag_Grasp()
calibration = Arm_Calibration()
num = 0
dp = []
xy = [90, 106]
msg = {}
threshold=120
debug_pos = False
model = "General"

# XYT parameter path XYT Parameter path
XYT_path="/home/jetson/dofbot_pro/dofbot_apriltag/scripts/XYT_config.txt"

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 controls

```
button_layout      = widgets.Layout(width='320px', height='60px',
align_self='center')
output = widgets.Output()
# 调整滑杆 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')

# 进入标定模式  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)

# 目标检测抓取  Target detection and capture
target_detection   = widgets.Button(description='target_detection',
button_style='info', layout=button_layout)
grap = widgets.Button(description='grap', button_style='success',
layout=button_layout)
# 退出  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_identify = widgets.VBox(
    [joint1_slider, joint2_slider, threshold_slider, calibration_model,
calibration_ok, calibration_cancel,
     target_detection, grap, exit_button],
    layout=widgets.Layout(align_self='center'));
controls_box = widgets.HBox([imgbox, 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)
```

- Switch Mode

```
def target_detection_Callback(value):
    global model,debug_pos
    model = 'Detection'
    with output: print(model)
    debug_pos = True
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)
grap.on_click(grap_Callback)
exit_button.on_click(exit_button_Callback)
```

- Main program

```
def camera():
    global color_hsv,model,dp,msg,debug_pos
    # 打开摄像头 Open camera
    capture = cv.VideoCapture(0, cv.CAP_V4L2)
    capture.set(cv.CAP_PROP_FRAME_WIDTH, 640)
    capture.set(cv.CAP_PROP_FRAME_HEIGHT, 480)
    # Be executed in loop when the camera is opened normally
    # 当摄像头正常打开的情况下循环执行
    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 model == 'Detection':
                img, msg = apriltag_Identify.getApriltagPosMsg(img)
                # print("Detection msg:", msg)
                if debug_pos:
                    debug_pos = False
                    print("detect msg:", msg)
            if len(msg)!= 0 and model == 'Grap':
                print("grasp msg:", msg)
                threading.Thread(target=target.target_stacking, args=
(msg,xy)).start()
                msg={}
                model="Detection"
            if model == 'Exit':
                capture.release()
                break
            fps.show_fps(img)
            imgbox.value = cv.imencode('.jpg', img)[1].tobytes()
        except Exception as e:
            print("program end")
            print(e)
            capture.release()
```

- start up

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

3. Start the program

Start the ROS node service

Open the system terminal and enter the following command. If it is already started, you don't need to start it again.

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

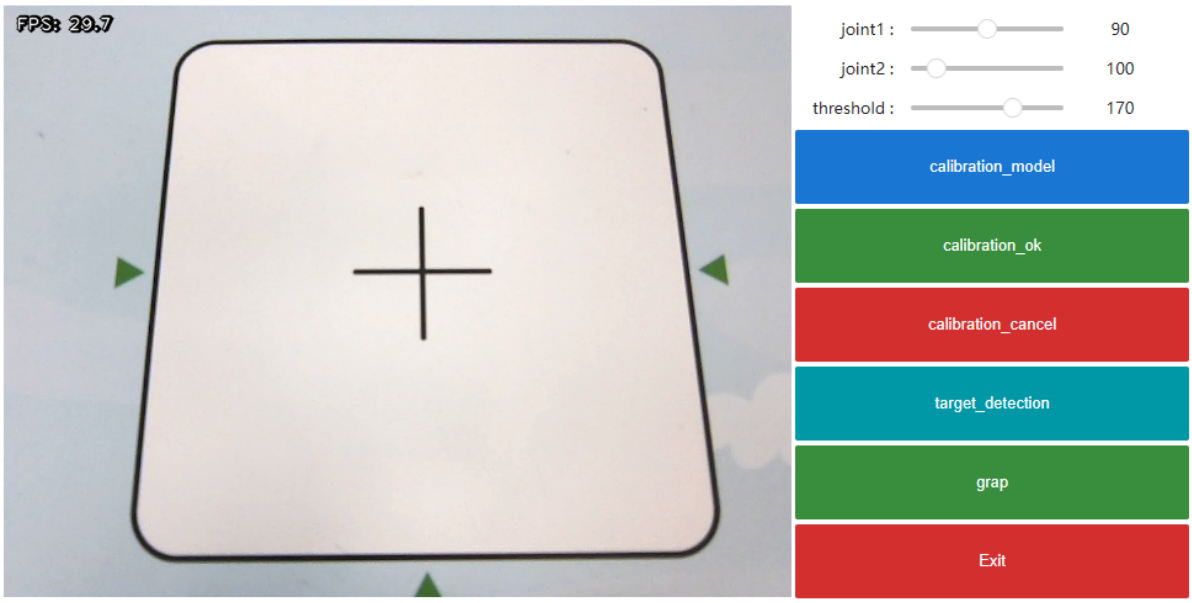
Start the program

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

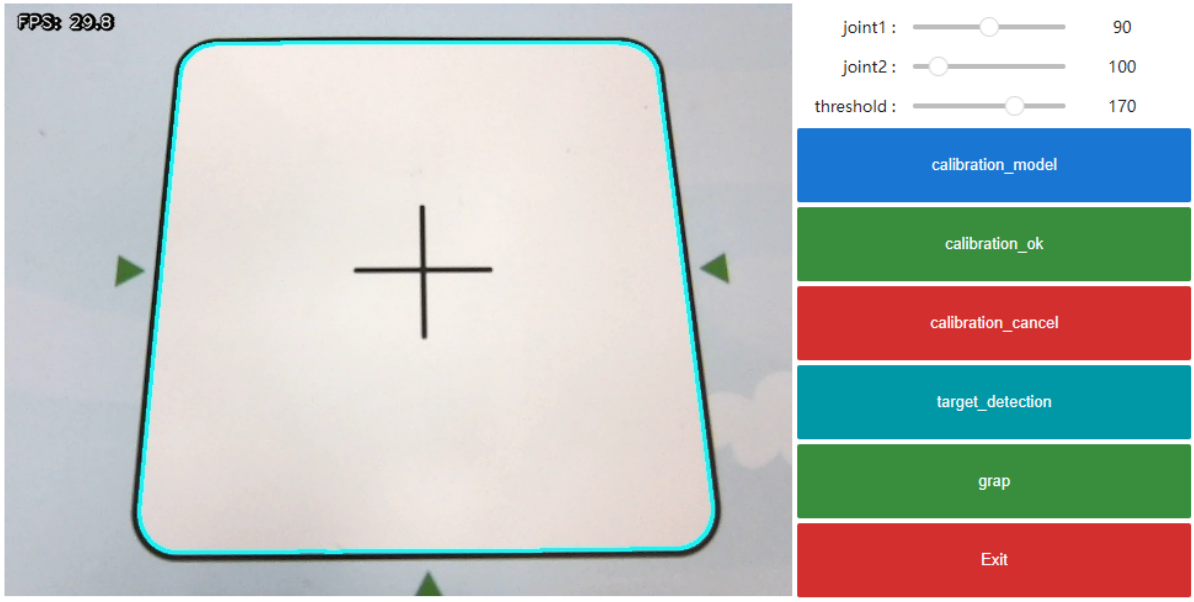
Then click Run All Commands.

4. Experimental operation and effect

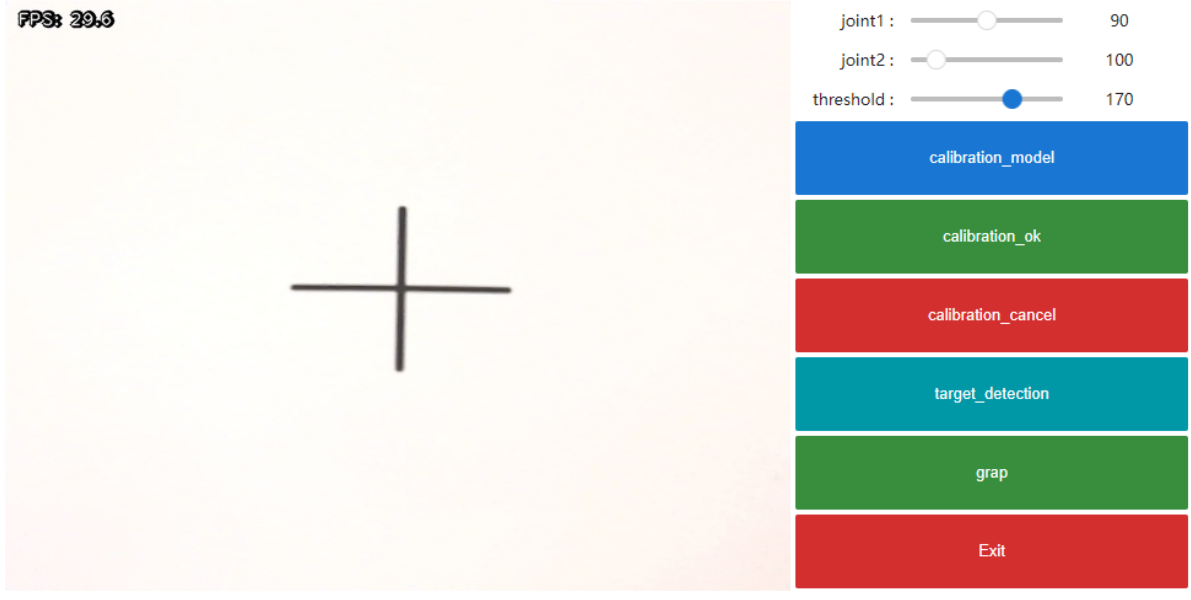
After the program is running, the jupyterlab webpage will display the control, the camera screen on the left, and the functions of the related buttons on the right.



Click [calibration_model] to enter the calibration mode. Adjust the upper robot joint slider and threshold slider to make the displayed blue line overlap with the black line in the recognition area.

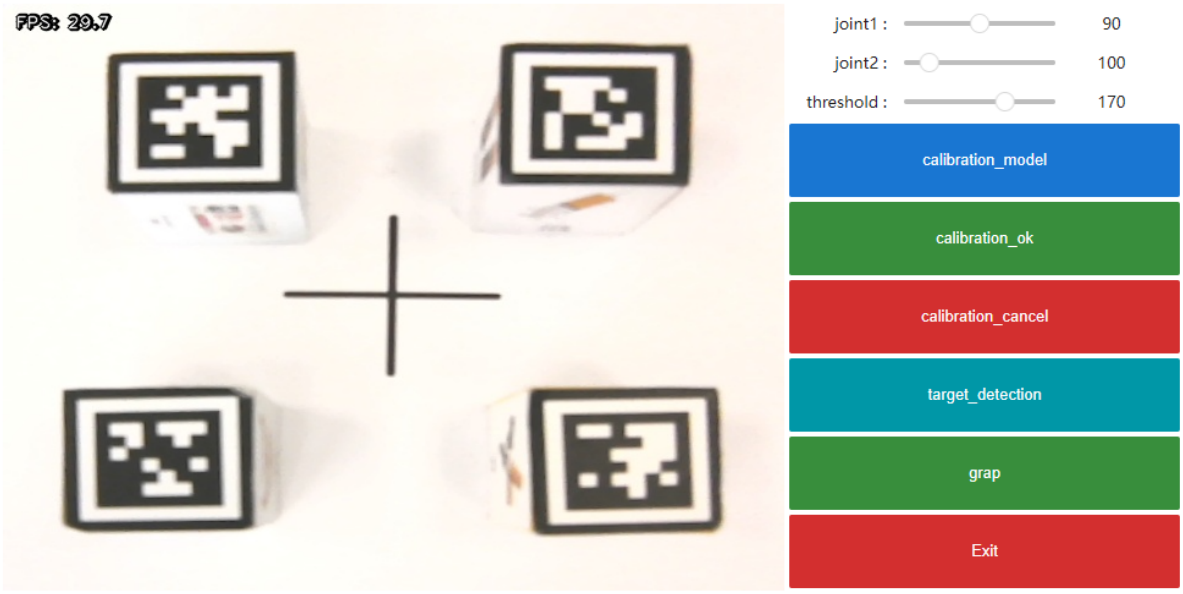


Click [calibration_ok] to calibrate OK. The camera screen will switch to the recognition area view.

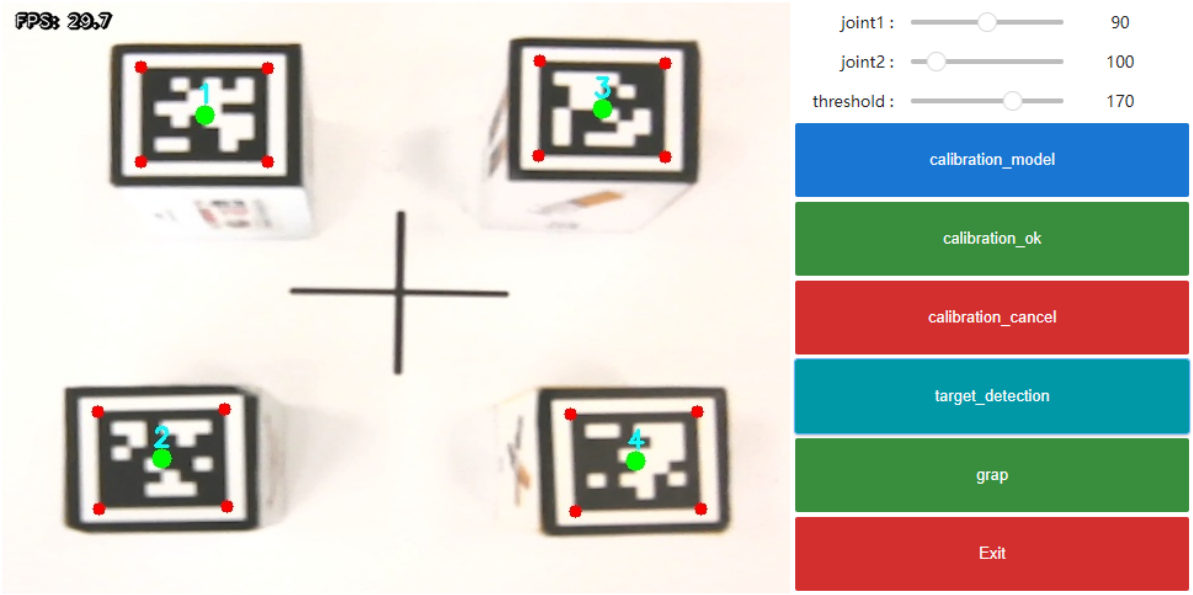


Place the building block in the recognition area, with the label code facing up and the position in the recognition area. Keep the bottom edge parallel to the bottom edge of the recognition area as much as possible.

Note: Due to the height of the building blocks, try to place them in the middle area when placing them, otherwise the building block label code may not be recognized.



Then click [target_detection] to start identifying the label code.



Then click the [grap] button to start stacking. The system will grab the building blocks according to the ID number sequence of the identified label code and stack them in the green area.

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