

Label Code Sorting

Orin board users can directly open a web page and enter IP address:8888 to access jupyter-lab and run directly. Jetson-Nano board users need to first enter the docker container, then enter the following command in docker:

```
cd  
jupyter-lab --allow-root
```

Then open a web page and enter IP address:9999 to access jupyter-lab and run the following program.

1. Function Description

Note: Before starting the program, please follow the [A2. Assembly Course] -> [Install the Map] tutorial to correctly install the map before proceeding with operations.

The robotic arm position calibration file is saved at
~/dofbot_pro/dofbot_apriltag/scripts/XYT_config.txt.

Code path:

```
#Jetson-Nano users need to enter the docker container to view  
~/dofbot_pro/dofbot_apriltag/scripts/Apriltag_Sorting.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 instances, 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参数路径 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 widgets

```
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(alignment='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(alignment='center'));
controls_box = widgets.HBox([imgbox, color_identify],
layout=widgets.Layout(alignment='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)

```

- Mode switching

```

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
    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_sorting, 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()

```

- 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.

```
ros2 run dofbot_pro_info kinematics_dofbot
```

Start the Program

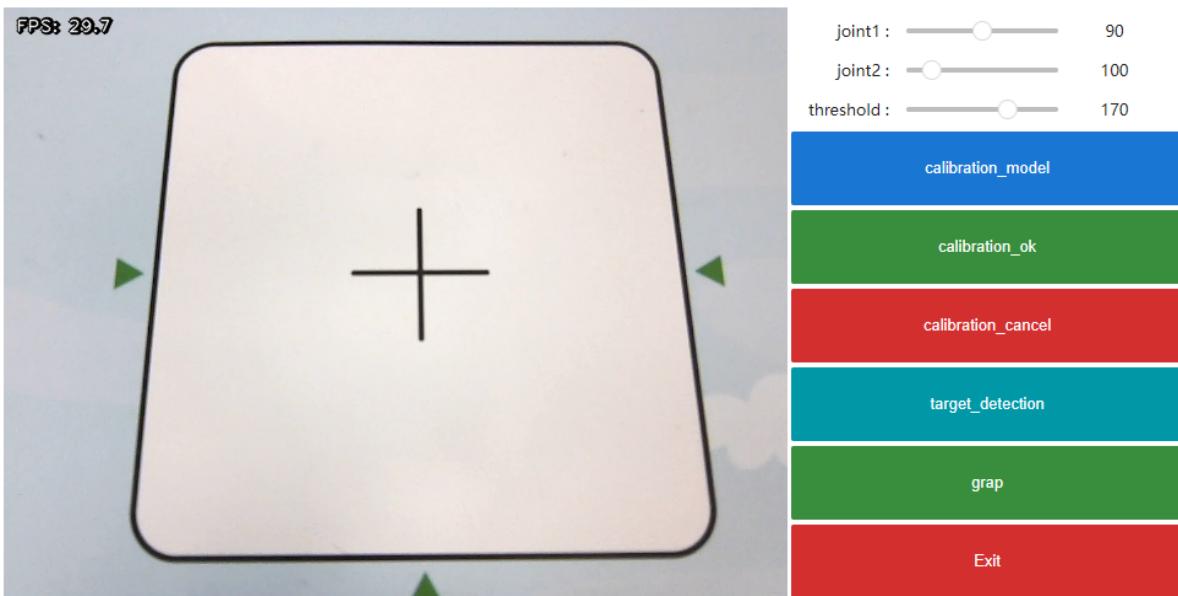
Open the jupyterlab webpage and find the corresponding .ipynb program file.

Then click the run all command.

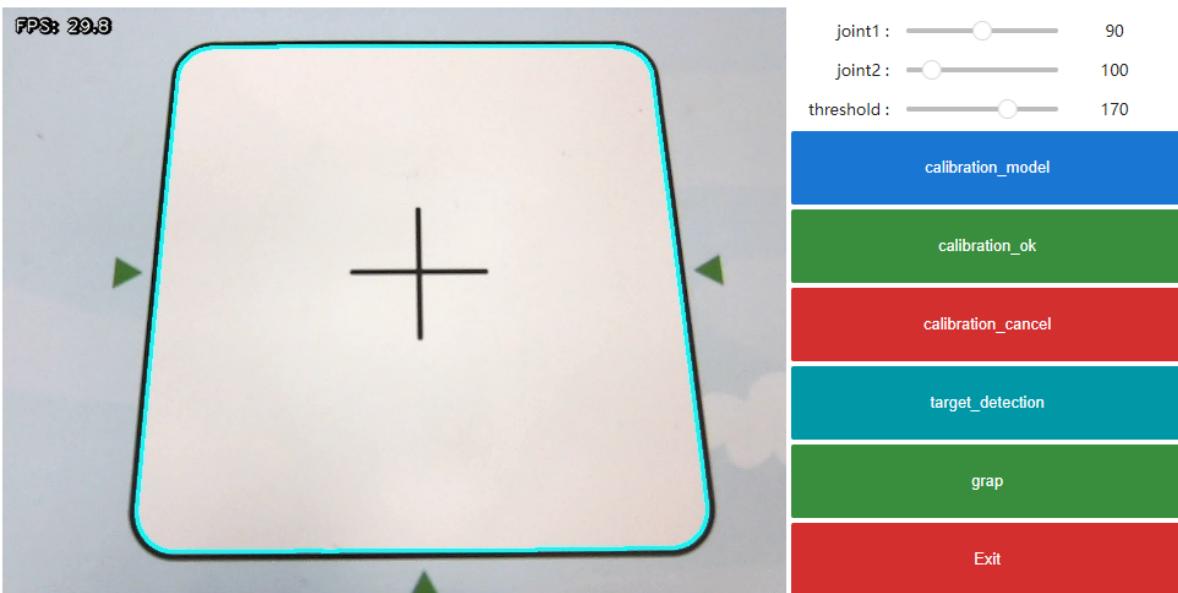


4. Operation and Effects

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.

FPS: 29.6

joint1 : 90
joint2 : 100
threshold : 170

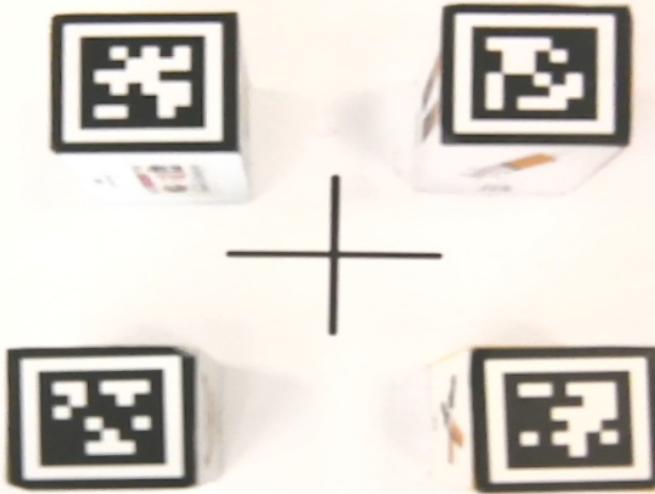


Place the building blocks in the recognition area with the label code side facing up, positioned properly within the recognition area, and try to keep the bottom edge parallel to the bottom edge of the recognition area.

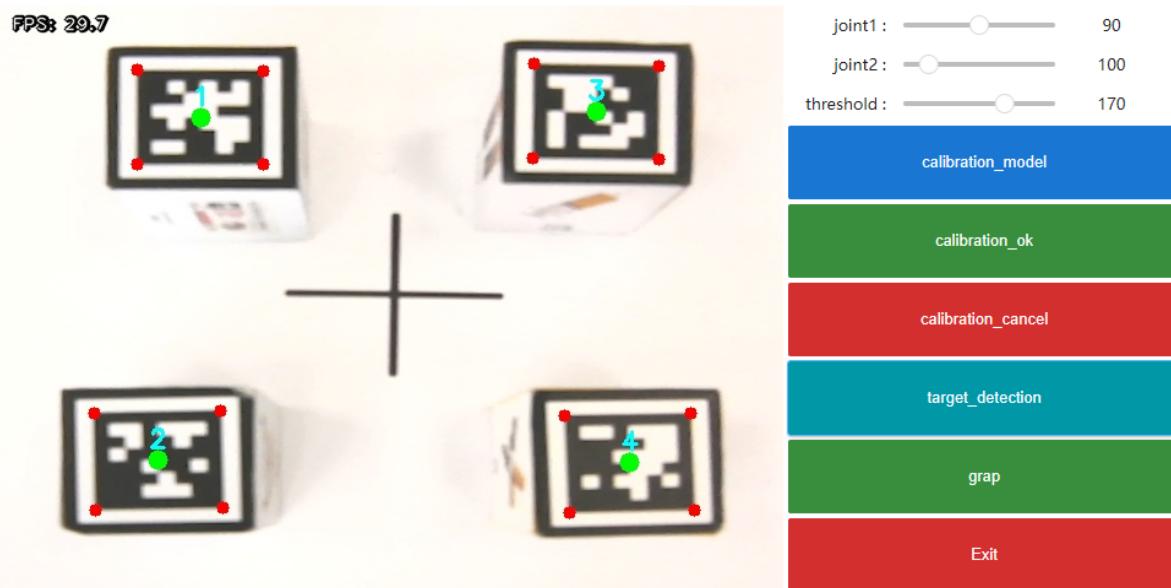
Note: Due to the height of the building blocks, try to place them in the central area when placing, otherwise the label codes on the building blocks may not be recognized.

FPS: 29.7

joint1 : 90
joint2 : 100
threshold : 170



Then click [target_detection] to start label code recognition.



Then click the [grap] button to start sorting. The system will sort the recognized label codes into the number areas according to ID number sequence.



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