Gesture Grasping Color Blocks

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.

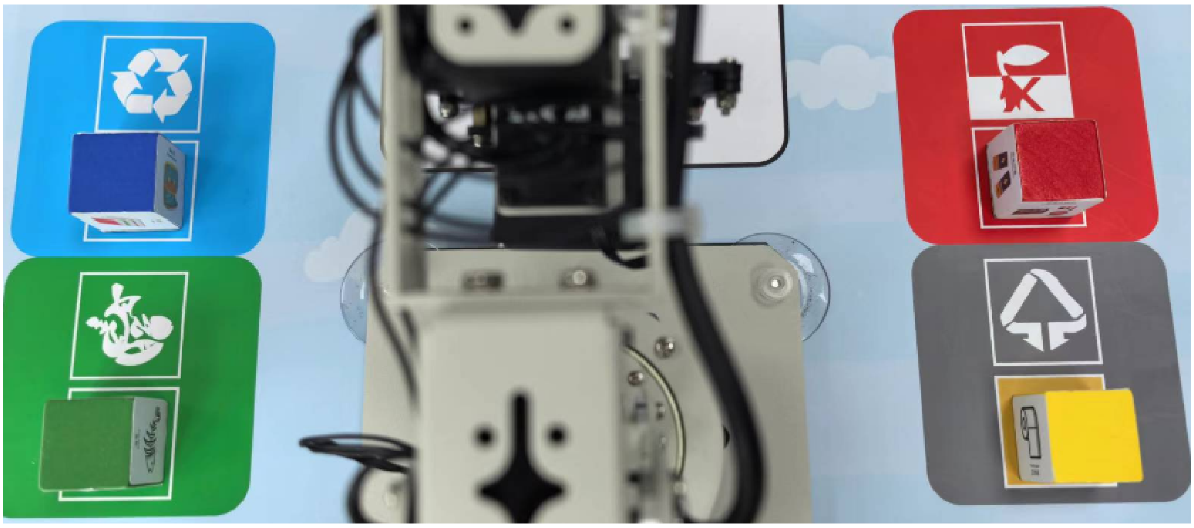
1. Gesture Recognition Description

The gesture recognition grasping function mainly combines mediapipe gesture recognition functionality, robotic arm and map gameplay. It recognizes a total of five gestures, gestures 1-5, where gestures 1-4 represent the grabbing positions 1-4 on the map and place the building blocks on the cross, while gesture 5 performs the gripper rotation action.

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

2. Experimental Setup

Place the building blocks at positions numbered 1-4.



3. Code Block Design

- Import header files

```
import cv2 as cv
import threading
import time
import ipywidgets as widgets
from IPython.display import display
from gesture_grasp import Gesture_Grasp
from dofbot_utils.fps import FPS
from dofbot_utils.robot_controller import Robot_Controller
```

- Create instances, initialize parameters

```
robot = Robot_Controller()
robot.move_init_pose()
fps = FPS()

gesture = Gesture_Grasp()
model = 'General'
```

- Create widgets

```
def exit_button_Callback(value):
    global model
    model = 'Exit'
    with output:
        print(model)

exit_button.on_click(exit_button_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 model, gesture
    # 打开摄像头 Open camera
    capture = cv.VideoCapture(0, cv.CAP_V4L2)
    capture.set(3, 640)
    capture.set(4, 480)
    # Be executed in loop when the camera is opened normally
    while capture.isOpened():
        try:
            _, img = capture.read()
            fps.update_fps()
            gesture.process(img)
            if model == 'Exit':
                capture.release()
                del gesture
                break
            fps.show_fps(img)
            imgbox.value = cv.imencode('.jpg', img)[1].tobytes()
            time.sleep(0.002)
        except Exception as e:
            print("program end")
            print(e)
            capture.release()
```

- Startup

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

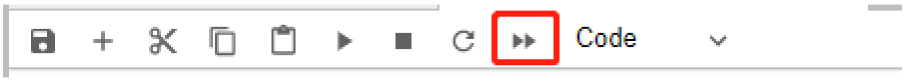
4. Start the Program

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

Code path:

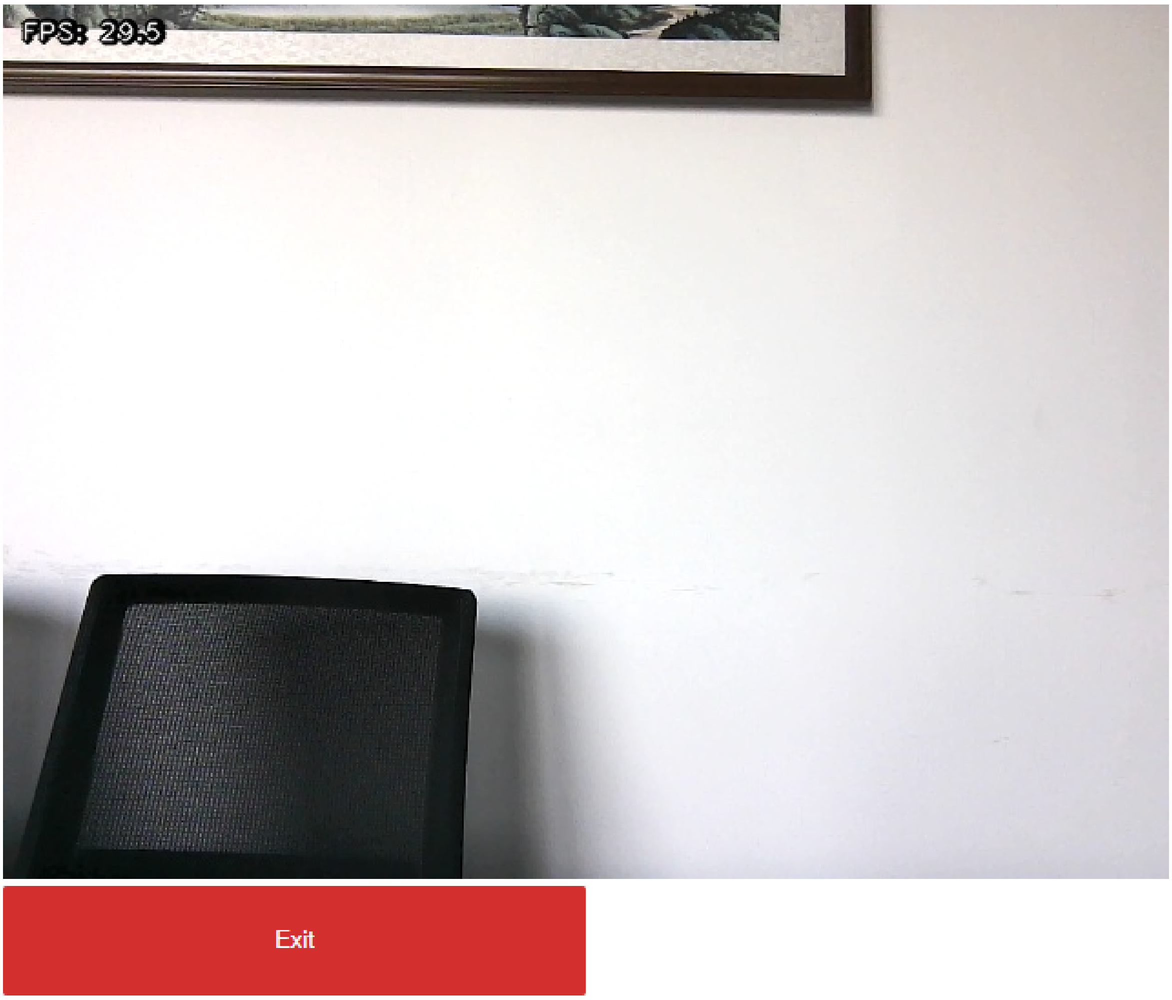
```
#Jetson-Nano users need to enter the docker container to view
~/dofbot_pro/dofbot_gesture/scripts/Gesture_Grasp.ipynb
```

Then click the run all command.



5. Experimental Effects

After the program runs, scroll to the bottom, and the jupyterlab webpage will display the camera view and related button functions.

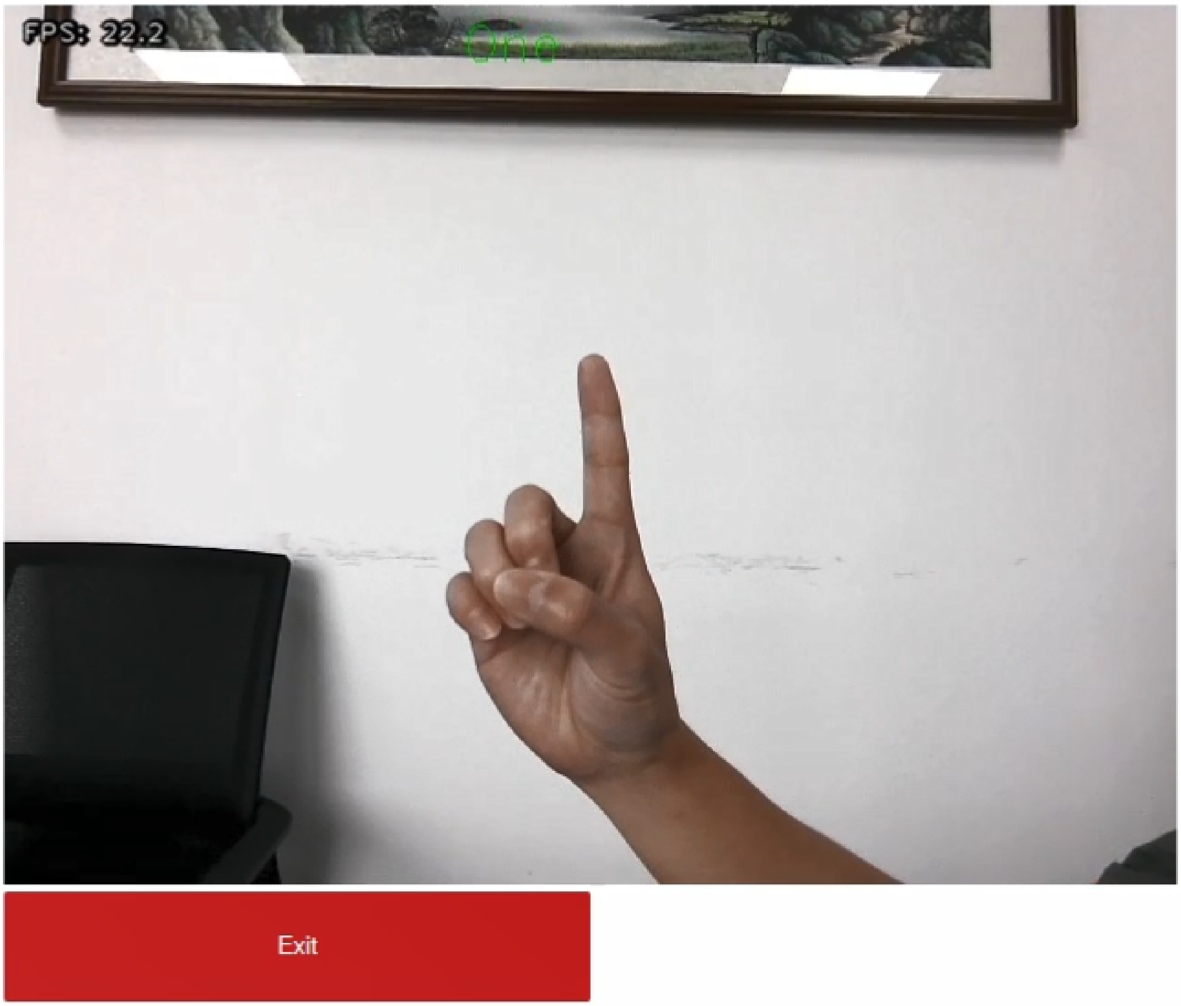


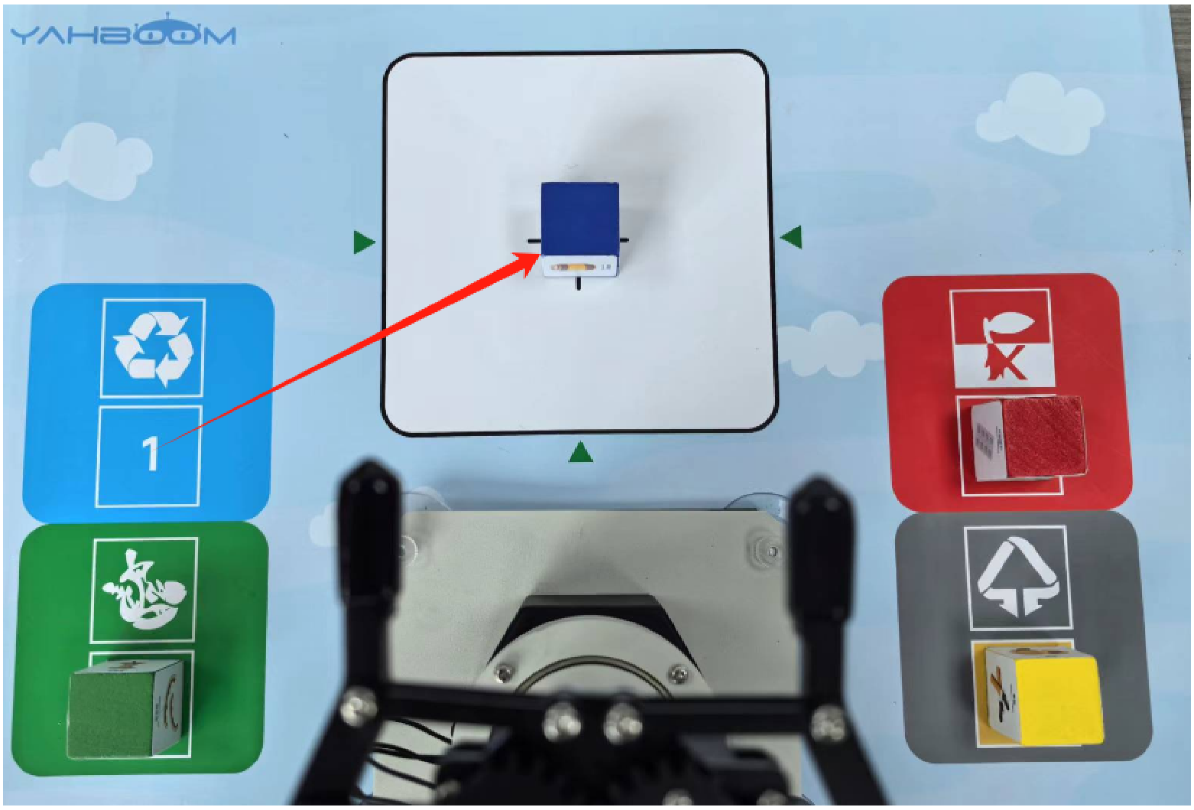
If a set gesture is recognized, the robotic arm will perform the corresponding action. When the robotic arm recognizes gesture 1, it will go to position 1 to grab the building block and place it on the center cross. After placement is complete, you need to remove the building block from the cross to avoid conflicts during the next placement. When the robotic arm recognizes gestures 2, 3, and 4, it will grab building blocks from the corresponding positions and place them on the cross. When the robotic arm recognizes gesture 5, it will perform the robotic arm gripper rotation action.

The gesture and action correspondence in this example is as follows:

Gesture	Function
Gesture 1	Grab building block from position 1 and place it on the center cross position
Gesture 2	Grab building block from position 2 and place it on the center cross position
Gesture 3	Grab building block from position 3 and place it on the center cross position
Gesture 4	Grab building block from position 4 and place it on the center cross position
Gesture 5	Rotate robotic arm gripper

As shown in the figure below:





If there are building blocks placed on the center cross, please remove the building blocks from the cross before starting gesture recognition.

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