3.Catch game

1.1 Introduction to gameplay

Catch game gameplay path: dofbot_ws/src/dofbot_color_sorting/catch game.ipynb

Start the code block, and the robot arm will automatically reach the recognition position and place the block in the gray square. After the robot arm has correctly recognized it for 10 times, it will automatically grab it and place it in the square of the corresponding color.

- Import header file

```
#!/usr/bin/env python
# coding: utf-8
import cv2 as cv
import threading
from time import sleep
from dofbot_config import *
import ipywidgets as widgets
from IPython.display import display
from color_sorting import color_sorting
```

- Initialize robotic arm position

```
import Arm_Lib
Arm = Arm_Lib.Arm_Device()
joints_0 = [90, 135, 0, 45, 90, 30]
Arm.Arm_serial_servo_write6_array(joints_0, 1000)
```

- Create instance, initialize parameters

```
# Create instance
sorting = color_sorting()
# Initialization mode
model = 'General'
# Color HSV Threshold
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 parameter path
HSV_path="/home/yahboom/dofbot_ws/src/dofbot_color_sorting/HSV_config.txt"
# Read the HSV configuration file and update the HSV value
try: read_HSV(HSV_path,color_hsv)
except Exception: print("Read HSV_config Error!!!")
```

- Create controls

```
# Create a control layout
button_layout = widgets.Layout(width='200px', height='70px',align_self='center')
# Output printing
output = widgets.Output()
# Exit button
exit_button=widgets.Button(description='Exit',button_style='danger',layout=butto
n_layout)
# Image control
imgbox = widgets.Image(format='jpg', height=480, width=640,
layout=widgets.Layout(align_self='center'))
# Vertical placement
controls_box = widgets.VBox([imgbox,
exit_button],layout=widgets.Layout(align_self='center'))
# ['auto','flex-start', 'flex-end', 'center', 'baseline', 'stretch', 'inherit',
'initial', 'unset']
```

- Control button

```
def   exit_button_Callback(value):
    global model
    model = 'Exit'
#    with output: print(model)
exit_button.on_click(exit_button_Callback)
```

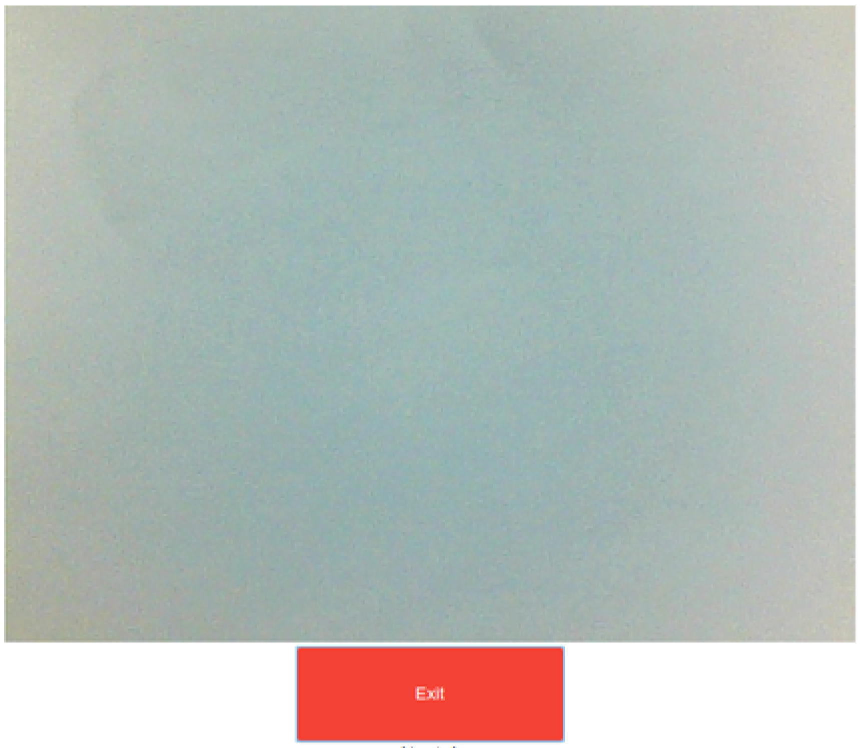
- Main program

```
def camera():
    # Turn on the camera
    capture = cv.VideoCapture(0)
    # Loop execution when the camera is opened normally
    while capture.isOpened():
        try:
            # Read every frame of the camera
            _, img = capture.read()
            # Uniform image size
            img = cv.resize(img, (640, 480))
            # Get exercise information
            img = sorting.Sorting_grap(img,   color_hsv)
            if model == 'Exit':
                cv.destroyAllWindows()
                capture.release()
                break
            # Add text
            imgbox.value = cv.imencode('.jpg', img)[1].tobytes()
        except KeyboardInterrupt:capture.release()
```

- start up

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

- Sample image



For detailed gameplay code, see dofbot_ws/src/dofbot_color_sorting/catch game.ipynb

1.2 Library code design

- HSV filters out the target color

```
# Convert image to HSV.
HSV_img = cv.cvtColor(mask, cv.COLOR_BGR2HSV)
# Filter out elements between two arrays.
img = cv.inRange(HSV_img, lowerb, upperb)
# Set all non-mask detection parts to black
mask[img == 0] = [0, 0,    0]
```

- Morphological transformation

```
# Get structural elements of different shapes
kernel = cv.getStructuringElement(cv.MORPH_RECT, (5, 5))
# Morphological closing operation
dst_img = cv.morphologyEx(mask, cv.MORPH_CLOSE, kernel)
```

- Find contours in binary image

```
# Convert image to grayscale
dst_img = cv.cvtColor(dst_img, cv.COLOR_RGB2GRAY)
# Image binarization operation
ret, binary = cv.threshold(dst_img, 10, 255, cv.THRESH_BINARY)
# Get the contour point set (coordinates)
contours, heriachy = cv.findContours(binary, cv.RETR_EXTERNAL,
cv.CHAIN_APPROX_SIMPLE)
```

- Calculate outline bounding box

```
for i, cnt in enumerate(contours):
    # The boundingRect function calculates the border value, x, y are the
coordinate values, w, h are the width and height of the rectangle
    x, y, w, h = cv.boundingRect(cnt)
    # Calculate the area of the contour
    area = cv.contourArea(cnt)
```

Obtain the target and drive the robotic arm to grab. The grabbing process is as follows:

Lift the robotic arm -> release the clamping jaw -> move to the block position -> tighten the clamping claw -> lift -> move to the target position -> release the clamping claw -> reset the robotic arm.