Color recognition

This part is mainly to prepare for the subsequent functional gameplay. The main steps:

- Convert the RGB image to be detected into an HSV image
- Define an object of Mat type: mask mask
- Define upper and lower color limits

The upper limit is a Scalar object, containing three values: hmin, smin, vmin, which represents the minimum value of the three elements of hsv;
The lower limit is also a Scalar object, containing three values: hmax, smax, vmax, which represents the maximum value of the three elements of hsv.

- Use the inRange function to detect whether each pixel of the src image is between lowerb and upperb

If so, the pixel is set to 255 and stored in the mask image, otherwise it is 0.

1. Basic principles

Commonly used models in digital image processing are RGB (red, green, blue) model and HSV (hue, saturation, brightness). RGB is widely used in color monitors and color video cameras. Our usual pictures are generally RGB models. . The HSV model is more in line with the way people describe and interpret colors. HSV's color description is natural and very intuitive to people. Another reason for choosing to use the HSV model is that the RGB channel cannot well reflect the specific color information of the object. Compared with the RGB space, the HSV space can express the lightness, shade, hue, and vividness of the color very intuitively, making it easy to carry out color analysis. contrast between.

2. HSV model

HSV (Hue, Saturation, Value) is a color space created by A. R. Smith in 1978 based on the intuitive characteristics of color, also known as the Hexcone Model. The parameters of color in this model are: hue (H), saturation (S), and lightness (V).

H: 0 — 180

S: 0 — 255

V: 0 — 255

- HSV parameter table:

	black	gray	white	red	orange	yellow	green	cyan	blue	purple	
H_min	0	0	0	0	156	11	26	35	78	100	125
H_max	180	180	180	10	180	25	34	77	99	124	155
S_min	0	0	0	43	43	43	43	43	43	43	
S_max	255	43	30	255	255	255	255	255	255	255	
V_min	0	0	0	46	46	46	46	46	46	46	
V_max	46	220	255	255	255	255	255	255	255	255	

3. Main code

Code path:/root/Dofbot/6.AI_Visuall/5.Color recognition.ipynb

The following code content needs to be executed according to the actual step. It cannot be run all at once. Running the last unit will directly exit the thread.

```
#bgr8 to jpeg format
import enum
import cv2
def bgr8_to_jpeg(value, quality=75):
    return bytes(cv2.imencode('.jpg', value)[1])
```

```
#Camera component display
import traitlets
import ipywidgets.widgets as widgets
import time
# Thread function operation library
import threading
import inspect
import ctypes

origin_widget = widgets.Image(format='jpeg', width=320, height=240)
mask_widget = widgets.Image(format='jpeg',width=320, height=240)
result_widget = widgets.Image(format='jpeg',width=320, height=240)

# Create a horizontal box container to place image widgets next to each other
image_container = widgets.HBox([origin_widget, mask_widget, result_widget])
# image_container = widgets.Image(format='jpeg', width=600, height=500)
display(image_container)
```

Get the hsv value of a color

```
def get_color(img):
    H = []
    color_name={}
    img = cv2.resize(img, (640, 480), )
    # Convert color image to HSV
    HSV = cv2.cvtColor(img, cv2.COLOR_BGR2HSV)
    # Draw a rectangular frame
    cv2.rectangle(img, (280, 180), (360, 260), (0, 255, 0), 2)
    # Take out the H, S, and V values of each row and column in turn and put
them into the container.
    for i in range(280, 360):
        for j in range(180, 260): H.append(HSV[j, i][0])
    # Calculate the maximum and minimum values of H, S, and V respectively
    H_min = min(H);H_max = max(H)
# print(H_min,H_max)
    # Determine color
    if H_min >= 0 and H_max <= 10 or H_min >= 156 and H_max <= 180:
color_name['name'] = 'red'
    elif H_min >= 26 and H_max <= 34: color_name['name'] = 'yellow'
    elif H_min >= 35 and H_max <= 78: color_name['name'] = 'green'
    elif H_min >= 100 and H_max <= 124: color_name['name'] = 'blue'
```

```
     return img, color_name
```

Main process: Identify red, green, blue and yellow colors.

```
import cv2
import numpy as np
import ipywidgets.widgets as widgets


cap = cv2.VideoCapture(0)
cap.set(3, 640)
cap.set(4, 480)
cap.set(5, 30) #Set frame rate
cap.set(cv2.CAP_PROP_FOURCC, cv2.VideoWriter.fourcc('M', 'J', 'P', 'G'))

# Red is selected by default, and the program will automatically switch colors based on the color detected in the box.
# red interval
color_lower = np.array([0, 43, 46])
color_upper = np.array([10, 255, 255])


def Color_Recongnize():

     while(1):
         # get a frame and show Get the video frame and convert it to HSV format. Use cvtColor() to convert the BGR format to HSV format. The parameter is cv2.COLOR_BGR2HSV.
         ret, frame = cap.read()
         frame, color_name = get_color(frame)
         if len(color_name)==1:
             global color_lower
             global color_upper

             if color_name['name'] == 'yellow':
                 color_lower = np.array([26, 43, 46])
                 color_upper = np.array([34, 255, 255])

             elif color_name['name'] == 'red':
                 color_lower = np.array([0, 43, 46])
                 color_upper = np.array([10, 255, 255])

             elif color_name['name'] == 'green':
                 color_lower = np.array([35, 43, 46])
                 color_upper = np.array([77, 255, 255])

             elif color_name['name'] == 'blue':
                 color_lower=np.array([100, 43, 46])
                 color_upper = np.array([124, 255, 255])

         origin_widget.value = bgr8_to_jpeg(frame)
         #cv2.imshow('Capture', frame)

         # change to hsv model
         hsv = cv2.cvtColor(frame, cv2.COLOR_BGR2HSV)
```

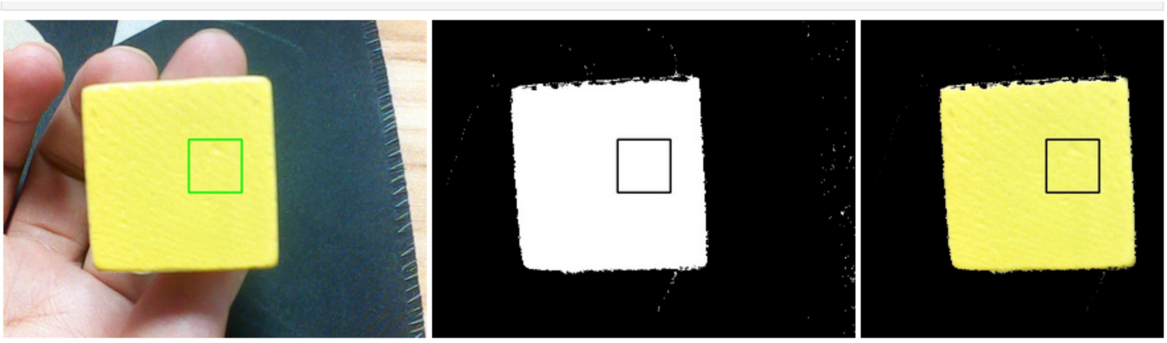
```
        # get mask Use the inRange() function and the upper and lower bounds of the blue range in the HSV model to obtain the mask. The blue part of the original video in the mask will be made white and the other parts black.
        mask = cv2.inRange(hsv, color_lower, color_upper)
        #cv2.imshow('Mask', mask)
        mask_widget.value = bgr8_to_jpeg(mask)


        # detect blue Perform a bitwise AND operation on the mask on the original video frame, then the white in the mask will be replaced with the real image:
        res = cv2.bitwise_and(frame, frame, mask=mask)
        #cv2.imshow('Result', res)
        result_widget.value = bgr8_to_jpeg(res)

        time.sleep(0.01)

    cap.release()
    #cv2.destroyAllWindows()
```

After the program block is run, you will see the camera component display.



4. Debugging method

If a certain color cannot be recognized during the color recognition process, you can modify the value of the color judgment as follows:

Uncomment `print(H_min,H_max)`, then put the unrecognized square into the recognition box, look at the H_min, H_max values output by the program, and then replace this value with the color judgment value.

```
def get_color(img):
    H = []
    color_name={}
    img = cv2.resize(img, (640, 480), )

    HSV = cv2.cvtColor(img, cv2.COLOR_BGR2HSV)

    cv2.rectangle(img, (280, 180), (360, 260), (0, 255, 0), 2)

    for i in range(280, 360):
        for j in range(180, 260): H.append(HSV[j, i][0])

    H_min = min(H);H_max = max(H)
```

```
     # print(H_min,H_max)

     # Color judgment
     if H_min >= 0 and H_max <= 10 or H_min >= 156 and H_max <= 180: color_name['name'] = 'red'
     elif H_min >= 25 and H_max <= 30: color_name['name'] = 'yellow'
     elif H_min >= 35 and H_max <= 78: color_name['name'] = 'green'
     elif H_min >= 100 and H_max <= 124: color_name['name'] = 'blue'
     return img, color_name
```