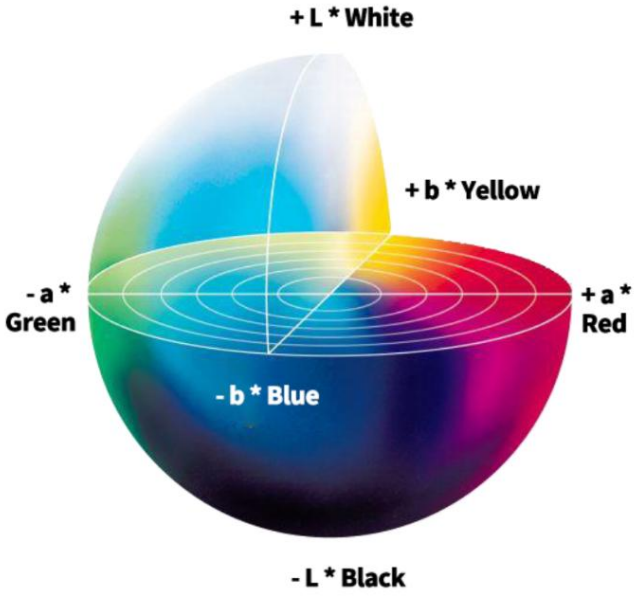
Lesson 3 Color Space Learning

1. Color Space Instruction

In the image information read by OpenCV, each frame is arranged by pixels composed of three color components of B, R and G.

Color model, also known as color space, is a mathematical model using a set of values to describe color. MasterPi uses LAB color space. LAB (CIELab, color, model) was established on the basis of the international standard for chromaticity developed by the International Commission on Illumination (CIE) in 1931.



L component: the brightness of pixel . The larger the L value, the higher the brightness.

a component: the color range from red to green.

b component: the range from yellow to blue.

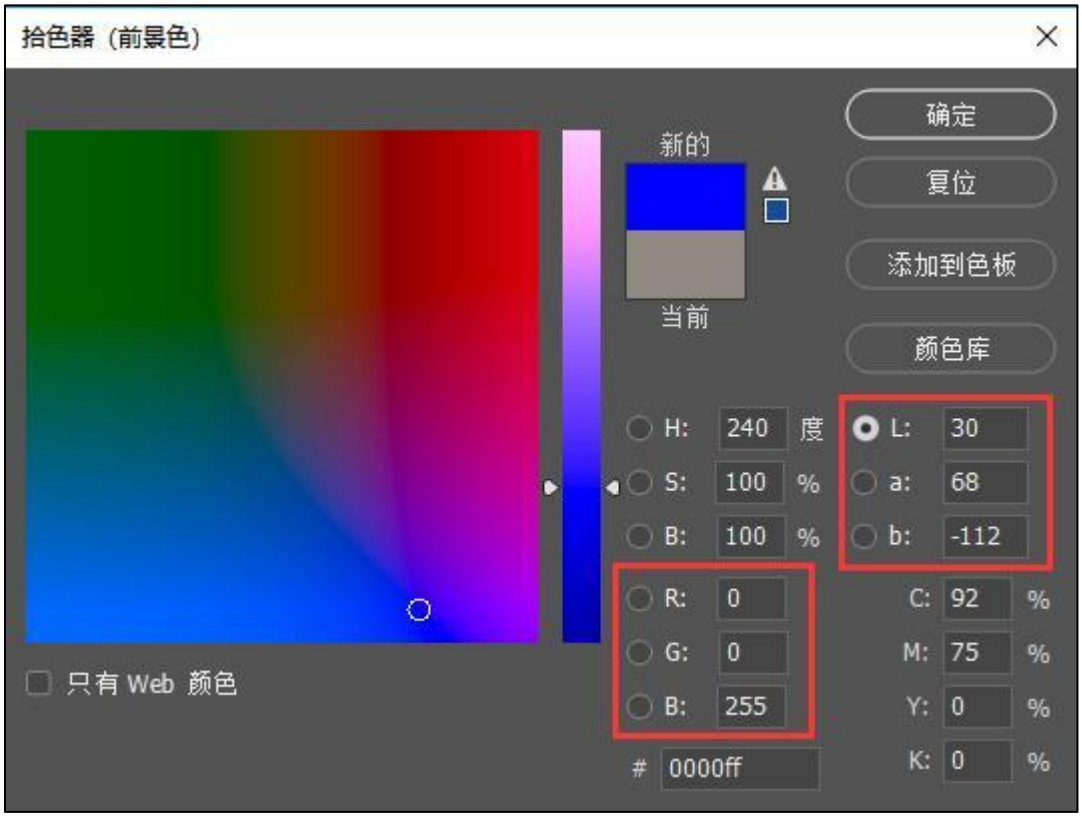
In OpenCV, the R,G and B values in RGB color space range from 0 to 225. However, L value in Lab space ranges from 0 to 100. When L value is 0, it

represents black. When L value is 100, it represents white. The values of a and b range from 127 to -128. When a and b values are 0, both represents gray.

To further learn about the contrast relationship between RGB and Lab. Here takes PS software as an example to illustrate:

1) In PS software, select colors with eyedropper tool.

2) Click “color picker” in the lower left corner. You can view the corresponding relationship between Lab and RGB:



After learning Lab color model, let’s look at OpenCV color conversion function:

```
cv2.cvtColor(frame, cv2.COLOR_RGB2LAB)
```

“frame” is the picture to be processed; “cv2.COLOR_RGB2LAB” is the specified color conversion mode. Here, converse the frame information in RGB color space into LAB color space.

The common color conversion table is as follow:

color conversion table

Colors	Red	Green	Blue	White	Black
RGB color space value	（255,0,0）	（0,255,0）	（0,0,255）	（255,255,255）	（0,0,0）
Lab color space value	（54,81,70）	（88，-79,81）	（30,68，-112）	（100,0,0）	（0,0,0）

2. Color Recognition

2.1 Project Purpose

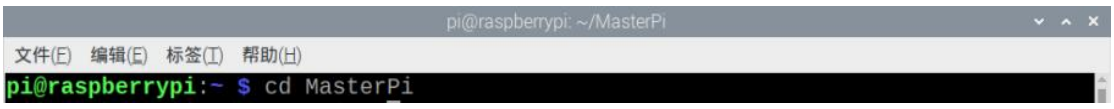
After recognizing red object, buzzer will make sound.

2.2 Operation Steps

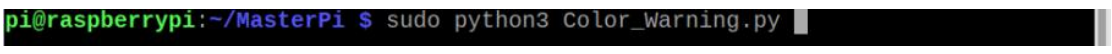
1) Turn on and connect VNC, then open VNC.

2) Click  to enter LX terminal.

3) Enter “cd MasterPi” command and press “Enter” to come to the program directory.

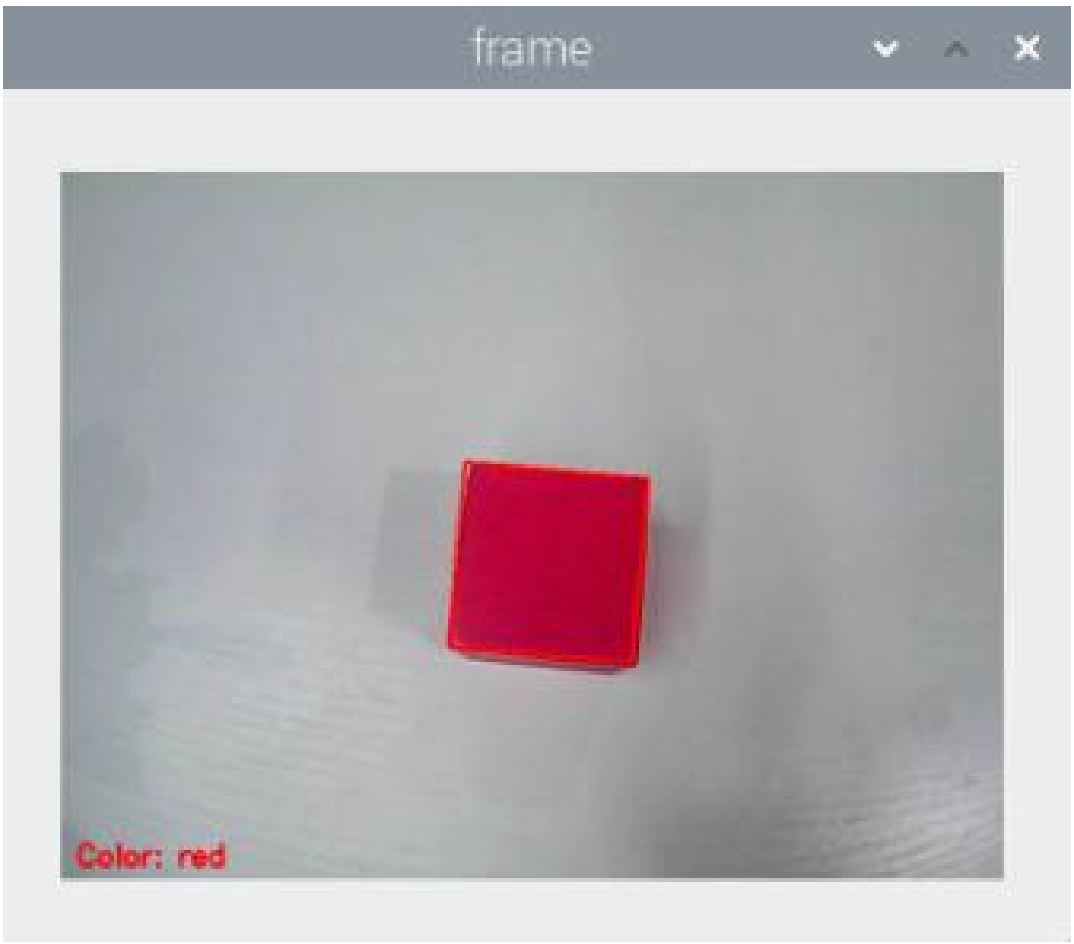


4) Enter “sudo python3 Color_Warning.py” command and press “Enter”.



5) If want to exit this game, you can press “Ctrl+C”. If fail to exit, please try a few more time.

2.3 Project Outcome



6) In the image transmitted by camera, object is recognized and framed, then display the color of recognized object. If the object color is red, buzzer will make sound.

2.4 Project Analysis

Firstly, recognize the object color. The color of object is converted through LAB space, and then frame the outline of the target after processing the image.

Then set buzzer feedback for recognition. When recognizing the corresponding color, buzzer will make sound, vice verse.

The source code of program is located in /home/pi/MasterPi/Color_Warning.py

```
145                 areaMaxContour, area_max = getAreaMaxContour(contours)  # 找出最大轮廓
146                 if areaMaxContour is not None:
147                     if area_max > max_area:  # 找最大面积
148                         max_area = area_max
149                         color_area_max = i
150                         areaMaxContour_max = areaMaxContour
151         if max_area > 2500:  # 有找到最大面积
152             rect = cv2.minAreaRect(areaMaxContour_max)
153             box = np.int0(cv2.boxPoints(rect))
154 
155             cv2.drawContours(img, [box], -1, range_rgb[color_area_max], 2)
156             if color_area_max == 'red':  # 红色最大
157                 color = 1
158             elif color_area_max == 'green':  # 绿色最大
159                 color = 2
160             elif color_area_max == 'blue':  # 蓝色最大
161                 color = 3
162             else:
163                 color = 0
164             color_list.append(color)
```

After getting the maximum contour through getAreaMaxContour function, the maximum area can be obtained with this parameter, then frame the object contour through **drawContours function**

Here, after the maximum contour ofobject is obtained by getAreaMaxContour function, the maximum area of object is obtained according to this parameter, and then the drawContours function is used to frame the contour of object. Finally, object color is compared in the set color list range_rgb.

The code “cv2.drawContours(img, [box], -1, range_rgb[color_area_max], 2)”.

The first parameter “img” is the targeted object.

The second parameter “[box]” is the four corner points required to draw the contour of rectangle.

The third parameter “-1” represents the whole contour of object is drawn.

The fourth parameter “range_rgb[color_area_max]” is the contour color.

The fifth parameter “**2**” is the contour width.

```
165                 if len(color_list) == 3:  # 多次判断
166                     # 取平均值
167                     color = int(round(np.mean(np.array(color_list))))
168                     color_list = []
169                     if color == 1:
170                         if time.time() > interval_time:
171                             interval_time = time.time() + 3
172                             for i in range(1):
173                                 setBuzzer(0.1)
174                                 time.sleep(0.1)
175                         detect_color = 'red'
176                         draw_color = range_rgb["red"]
```

Determine whether the recognized color is red first. It it is, set buzzer to make sound by calling serBuzzer function. The parameter in function is the duration of sound. The time unit is second.

```
65  # 设置蜂鸣器
66  def setBuzzer(timer):
67      Board.setBuzzer(0)
68      Board.setBuzzer(1)
69      time.sleep(timer)
70      Board.setBuzzer(0)
71
```