2. OpenCV geometric transformation

Before running the sample program, you need to switch to the directory where the code is located. SSH connects the car, runs at the terminal,

```
cd /userdata/yahboomcar_ws/src/yahboomcar_astra/opencv_examples
```

2.1. Image scaling

After the car terminal switches to the directory where the code is located, run the program,

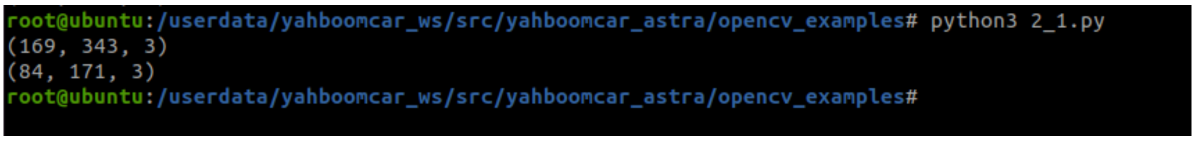
```
python3 2_1.py
```

```
import cv2
if __name__ == '__main__':
    img = cv2.imread('figures/yahboom.jpg')
    print(img.shape)
    x, y = img.shape[0:2]
    img_resize = cv2.resize(img, (int(y / 2),   int(x / 2)))
    cv2.imwrite('figures/2_1.jpg', img_resize)
    print(img_resize.shape)

'''
图像缩放：cv2.resize(InputArray src,OutputArray dst,Size,fx,fy,interpolation)
    InputArray src：输入图片
    OutputArray ds：输出图片
    Size：输出图片尺寸
    fx,fy：沿x轴，y轴的缩放系数
    interpolation：插入方式，有以下选择，
        INTER_NEAREST（最近邻插值）
        INTER_LINEAR（双线性插值，默认设置）
        INTER_AREA（使用像素区域关系进行重采样）
        INTER_CUBIC（4x4像素邻域的双三次插值）
        INTER_LANCZOS4（8x8像素邻域的Lanczos插值）
Zoom: cv2. Resize (InputArray SRC, OutputArray DST, Size, fx, fy, interpolation)
    InputArray src: Input the image
    OutputArray ds: Output the image
    Size: size of the output image
    fx,fy: Scale factor along the X-axis, Y-axis
    interpolation: Interpolation, available from the following,
        INTER_NEAREST
        INTER_LINEAR (default)
        INTER_AREA (resampling using pixel area         relationships)
        INTER_CUBIC (bicubic interpolation in 4x4       pixel neighborhood)
        INTER_LANCZOS4 (Lanczos interpolation for 8x8       pixel neighborhood)
```

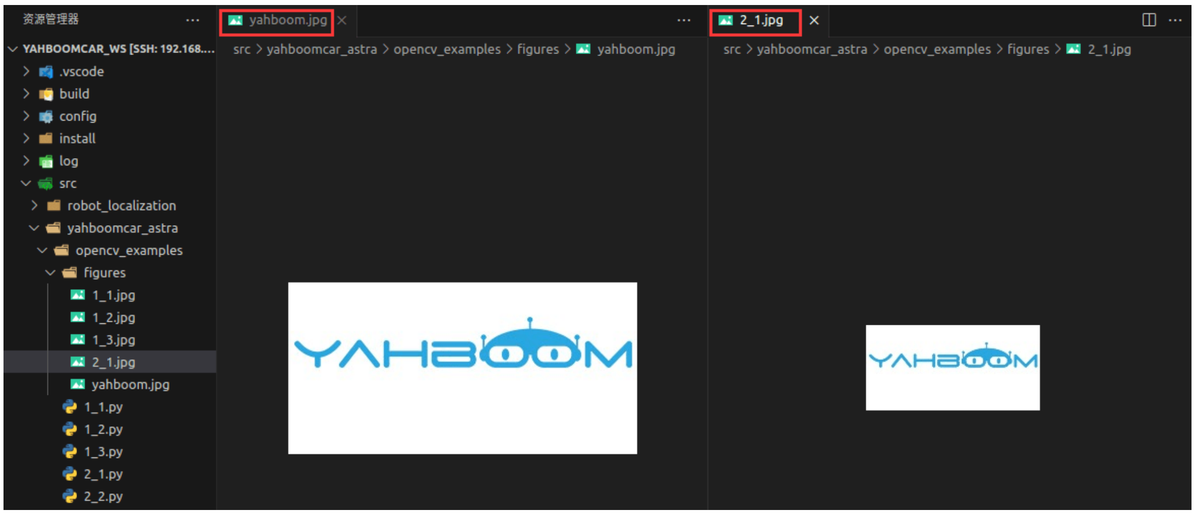
```
'''
```

Terminal output the size of the original image and the reduced image (representing the width, height and number of channels of the image, respectively),



```
root@ubuntu:/userdata/yahboomcar_ws/src/yahboomcar_astra/opencv_examples# python3 2_1.py
(169, 343, 3)
(84, 171, 3)
root@ubuntu:/userdata/yahboomcar_ws/src/yahboomcar_astra/opencv_examples#
```

Open the image and you can see the difference in size,



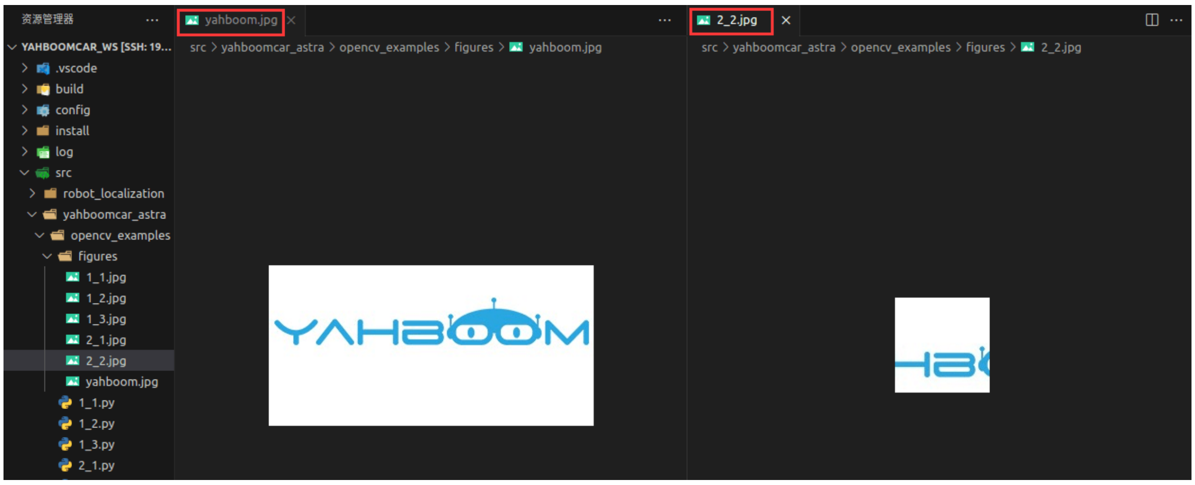
2.2. Image cropping

After the car terminal switches to the directory where the code is located, run the program,

```
python3 2_2.py
```

```python
import cv2
if __name__ == '__main__':
    img = cv2.imread('figures/yahboom.jpg')
    dst = img[0:100,100:200] # 选取区域X: 0-100 Y: 100-200, 不能超过原图像分辨率
    # Select the region X: 0-100 Y: 100-200, can not exceed the original image
resolution
    cv2.imwrite('figures/2_2.jpg', dst)
```

The resulting image is shown here,



2.3. Image translation

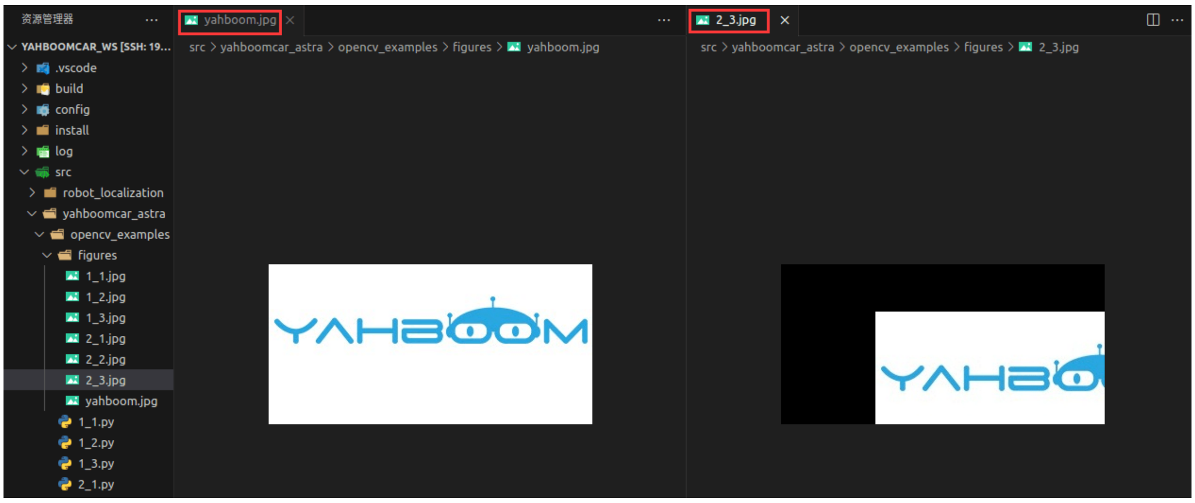
After the car terminal switches to the directory where the code is located, run the program,

```
python3 2_3.py
```

```
import cv2
import numpy as np
if __name__ == '__main__':
    img = cv2.imread('figures/yahboom.jpg')
    imgInfo = img.shape
    height = imgInfo[0]
    width = imgInfo[1]
    matShift = np.float32([[1,0,100],[0,1,50]]) # 2*3
    dst = cv2.warpAffine(img, matShift, (width,height))
    cv2.imwrite('figures/2_3.jpg', dst)

'''
图像平移：cv2.warpAffine(src,M,dsize[,dst[,flags[,borderMode[,borderValue]]]])
    src：输入图像
    M：仿射变换矩阵，一般反映平移或旋转的关系（InputArray类型）
    dsize：输出图像的大小
    flags：插值方法的组合（int类型）
    borderMode：边界像素模式（int类型）
    borderValue：（重点！）边界填充值；默认情况下，它为0
一般只设置前三个参数就可以实现基本的仿射变换效果。
Image translation:
cv2.warpAffine(src,M,dsize[,dst[,flags[,borderMode[,borderValue]]]])
    src: Input the image
    M: Affine transformation matrix, generally reflecting translation or rotation
relations (InputArray type)
    dsize: indicates the size of the output image
    flags: Combination of interpolation methods (int type)
    borderMode: Border pixel mode (int type)
    borderValue: (Point!) Boundary filling value; By default, it is 0,Generally,
only the first three parameters can be set to achieve the basic affine
transformation effect.
'''
```

The resulting image is shown here,



> **How to get the transformation matrix M? Here is an example,**

> Convert the original image src to the target image dst through the transformation matrix M:
>
> dst(x, y) = src(M11x + M12y+M13, M21x+M22y+M23)
>
> Move the original image src by 100 to the right and 50 pixels down, and the corresponding relationship is as follows:
>
> dst(x, y) = src(x+100, y+50)
>
> To complete the above expression, namely:
>
> dst(x, y) = src(1·x + 0·y + 100, 0·x + 1·y + 50)
>
> According to the above expression, it can be determined that the values of each element in the corresponding transformation matrix M are:
>
> M11=1, M12=0, M13=100, M21=0, M22=1, M23=50.
>
> Substituting the above values into the transformation matrix M, we get:
>
> M = [[1,0,100],[0,1,50]]

2.4.Image mirroring

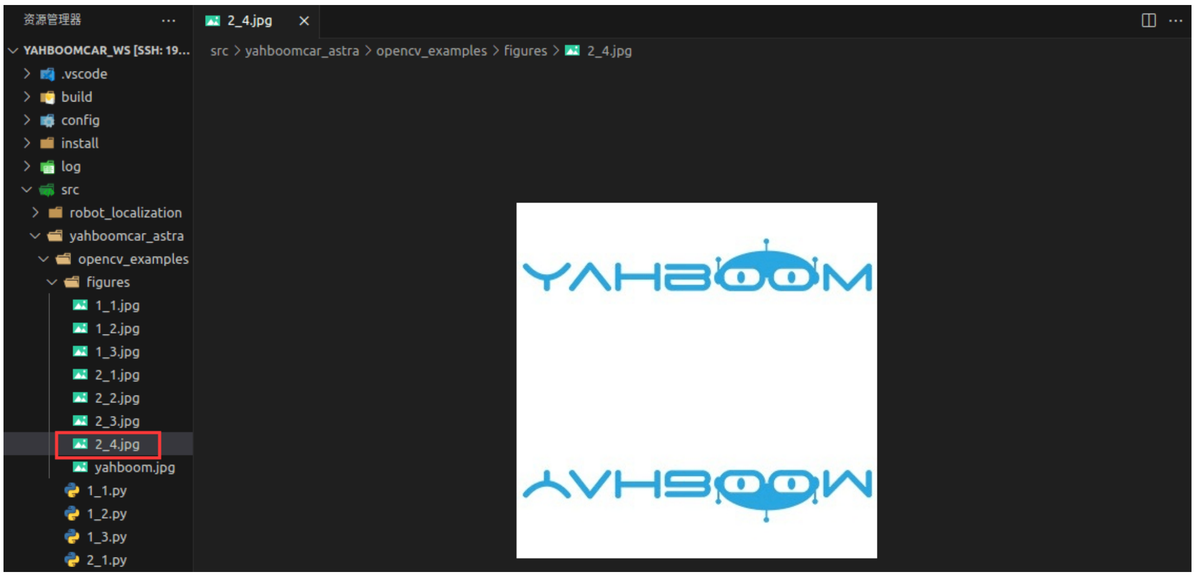
> There are two kinds of image image transformation: horizontal image and vertical image. The horizontal mirror takes the vertical center line of the image as the axis, and swaps the pixels of the image, that is, switches the left half of the image and the right half of the image. Vertical mirroring is based on the horizontal center line of the image as the axis, the upper part of the image and the lower part of the image.
>
> Transformation principle:
>
> Set the width of the image to width and the length to height. (x,y) is the coordinate after transformation, (x0,y0) is the coordinate of the original image,
>
> - Horizontal mirror transform
>
> Forward mapping: x=width-x0-1,y=y0
>
> Backward mapping: x0=width-x-1,y0=y
>
> - Vertical mirror transform
>
> Map up: x=x0,y=height-y0-1
>
> Downward mapping: x0=x, y0=height-y-1
>
> Summary: In the horizontal image transformation, the entire image is traversed, and then each pixel is processed according to the mapping relationship. In fact, the horizontal mirror transformation is to change the column of the image coordinate to the right, and the right column to the left, which can be transformed in column units. The same is true of the vertical mirror image transformation, which can be transformed in units of behavior.

The following takes vertical transformation as an example, after the car terminal switches to the directory where the code is located, run the program,

```
python3 2_4.py
```

```
import cv2
import numpy as np
if __name__ == '__main__':
    img = cv2.imread('figures/yahboom.jpg')
    imgInfo = img.shape
    height = imgInfo[0]
    width = imgInfo[1]
    deep = imgInfo[2]
    newImgInfo = (height*2,width,deep)
    dst = np.zeros(newImgInfo,np.uint8)#uint8
    for i in range(0,height):
        for j in range(0,width):
            dst[i,j] = img[i,j]
            dst[height*2-i-1,j] = img[i,j]
    cv2.imwrite('figures/2_4.jpg', dst)
```

The resulting image is shown here,



资源管理器
2_4.jpg
YAHBOOMCAR_WS [SSH: 19...
.vscode
build
config
install
log
src
robot_localization
yahboomcar_astra
opencv_examples
figures
1_1.jpg
1_2.jpg
1_3.jpg
2_1.jpg
2_2.jpg
2_3.jpg
2_4.jpg
yahboom.jpg
1_1.py
1_2.py
1_3.py
2_1.py
src > yahboomcar_astra > opencv_examples > figures > 2_4.jpg
YAHBOOM