1. Introduction to OpenCV

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
```

1.1. Image loading and saving

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

```
python3 1_1.py
```

```python
import cv2
if __name__ == '__main__':
    img = cv2.imread('figures/yahboom.jpg')
    cv2.imwrite("figures/1_1.jpg",img)

'''
图像读取：cv2.imread(filepath,flags)
    filepath：要读入图像的完整路径
    flags：如何读取图像
        cv2.IMREAD_UNCHANGED：保持原格式不变，可以用-1表示；
        cv2.IMREAD_GRAYSCALE：以灰度模式读入图片，可以用0表示；
        cv2.IMREAD_COLOR：，读入一副彩色图片，可以用1表示；
        cv2.IMREAD_UNCHANGED：读入一幅图片，并包括其alpha通道，可以用2表示。
图像保存：cv2.imwrite(filepath, img)
    filepath：保存的图像完整路径
    img：要保存的图像
    Image read: cv2.imread(filepath,flags)
    filepath: The full path of the image to be read
    flags: How to read images
    cv2.IMREAD_UNCHANGED: The format remains unchanged. The value can be -1.
    cv2.IMREAD_GRAYSCALE: Read images in grayscale mode, which can be represented
by 0.
    cv2.IMREAD_COLOR:, read a color picture, can be represented by 1;
    cv2.IMREAD_UNCHANGED: Reads an image and includes its alpha channel, which
can be represented by 2.
    Image save: cv2.imwrite(filepath, img)
    filepath: Save the full path of the image
    img: Image to save
'''
```
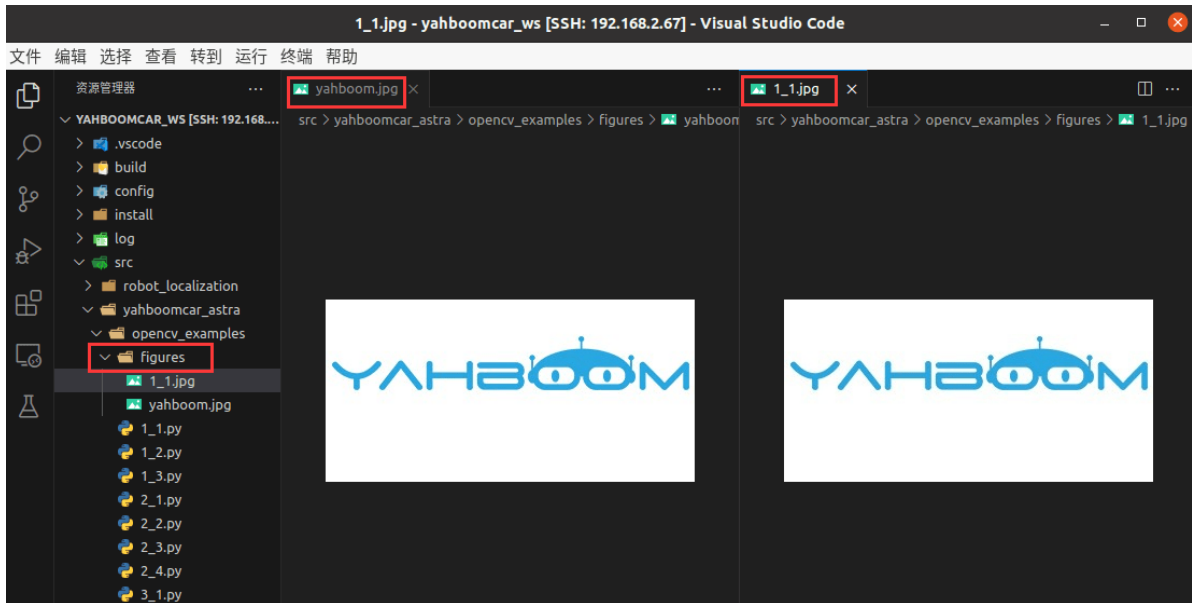
When run, the program reads the figures/yahboom.jpg image and saves the read image as figures/1_1.jpg.

SSH to the car in VSCode, access path,

```
/userdata/yahboomcar_ws/src/yahboomcar_astra/opencv_examples/figures
```

You can view the read image yahboom.jpg and the saved image 1_1.jpg:

> Note: opencv also has an important function cv.imshow(), which is used for image display. Since the car system has no graphical interface can not use this function to show, so here is not introduced, and will not be used later.

1.2. Camera reading and displaying

Note: This step applies to cars equipped with depth cameras.

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

```
python3 1_2.py
```

```python
import cv2
if __name__ == '__main__':
    frame = cv2.VideoCapture(8)
    if frame.isOpened():
        ret,img = frame.read()
        cv2.imwrite('figures/1_2.jpg',img)
    frame.release()

'''
打开摄像头：cv2.VideoCapture(args["videoPath"])
    这里参数为8，代表Astra相机；
    若参数是视频文件路径则打开视频，如cv2.VideoCapture("../test.avi")
读取图像数据：ret,img = frame.read()
    ret：一个bool值，判断是否读回正确的帧
    img：该帧的图像数据
Open the camera: cv2.VideoCapture(args[" videoPath "])
    Here the parameter is 8, representing Astra camera;
    If the parameter is the video file path, open the video, for example,
cv2.VideoCapture("... /test.avi")
Read image data: ret,img = frame.read()
```
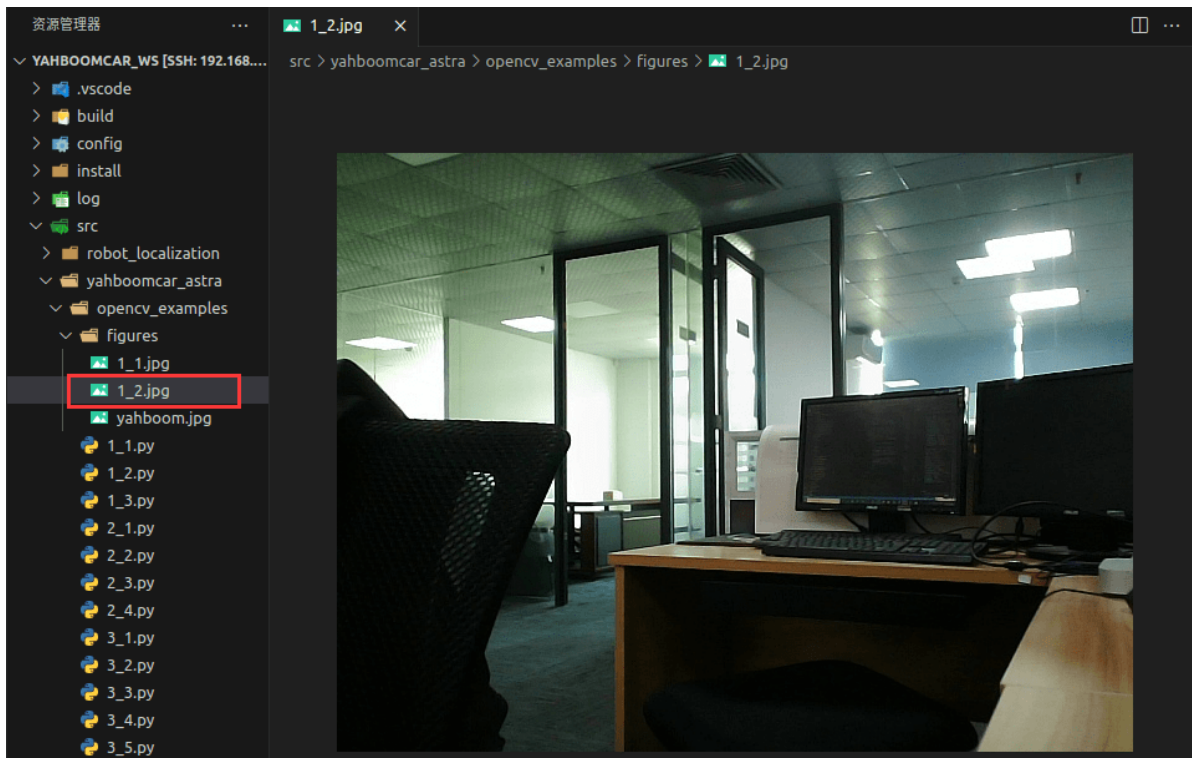
```
      ret: indicates a bool value that determines whether the correct frame is read
  back
      img: Image data for this frame
  '''
```

After running, the program reads a frame of camera image data and saves the read frame to figures/1_2.jpg.

1.3. Reading and Modifying pixels

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

```
python3 1_3.py
```

```python
import cv2
if __name__ == '__main__':
    img = cv2.imread('figures/yahboom.jpg')
    (b,g,r) = img[100,100] # 读取像素值# Read pixel values
    print(b,g,r)
    for i in range(0,10):
        for j in range(0,200):
            img[i,j] = (0,0,0) # 修改像素值# Modify pixel values
    cv2.imwrite("figures/1_3.jpg",img)
```

The terminal outputs the pixel value at the position of coordinates (100, 100),

After saving, some pixels in the upper left corner of the image are changed to black: