Chapter1: Preparation before class

The program development environment is based on **Python 2.7, OpenCV 3.4.0/2.4.9** version, and the hardware platform is the **Raspberry Pi 3B+** version. Maybe not compatible with python3.
But the tutorial will include "How to use OpenCV3 with Python3 on a PC".

In this course, we will learn how to Download the appropriate compiler and how to download OpenCV source code, after configuring the Raspberry Pi image system.

!!!Note:The source code for this tutorial is stored in the /home/pi/yahboom and /home/pi/Adafruit_Python_PCA9685 folders in the Raspberry Pi system.

1.1 Introduction of OpenCV

1.1.1 Introduction of OpenCV

The open source computer vision environment OpenCV is used by the Raspberry Pi image processing part. OpenCV is the abbreviation of Open Source Computer Vision Library.
It is a cross-platform computer vision library based on open source distribution. It realize many general algorithms in image processing and computer vision, and it is one of the most powerful research tools in computer vision.
The underlying OpenCV is written in C and C++. It can run on multiple operating systems (Linux, Windows, Mac, Andorid, iOS, etc.) and it provides API interfaces for many programming languages. In this tutorial, some simple computer vision processing is done based on the Python interface.

Application areas of OpenCV: robot vision, pattern recognition, machine learning, factory automation production line product inspection, medical imaging, camera calibration, remote sensing images, etc.
OpenCV can solve problems: human-computer interaction, robot vision, motion tracking, image classification, face recognition, object recognition, feature detection, video analysis, depth imaging, etc.

But we also have to face the problem that the Raspberry Pi own performance is difficult to run on high computational OpenCV projects. We have to consider and optimize problems such as delays.

OpenCV official homepage:https://www.opencv.org
OpenCV Chinese forum:http://www.opencv.org.cn
OpenCV CSDN forum:https://bbs.csdn.net/forums/OpenCV

1.2 Install OpanCV source code on the Raspberry Pi

1.2.1 Raspberry Pi development environment

After completing the hardware assembly according to the installation steps of the manual,as shown in Figure 1-1 below.

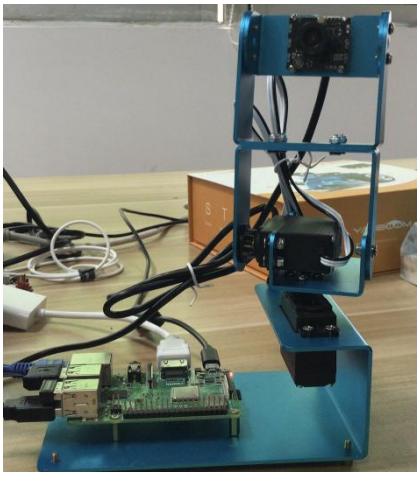


Figure 1-1

First we need to insert the keyboard and mouse that the Raspberry Pi system and camera will use, HDMI access monitor, power and USB camera.

Note: we are not using the BST-AI expansion board and two servos at this time. In the following chapters we will describe how to use the BST-AI expansion board to drive the servos.

The Raspberry Pi encourages users to use Python and C++ as their development language, so in principle, you don't need to install the Python compiler, but the Python (IDLE) and Thonny Python IDE that comes with the Raspberry Pi are too simplistic and not suitable for python users perform complex OpenCV development. Spyder is recommended here as the Python IDE for the Raspberry Pi.

We need to input:

```
sudo apt-get install spyder
```

You need some time to waiting for the installation to complete.

After the installation is complete, we can see Spyder in the menu of Raspberry Pi.

Note:

1. Please do not input "sudo apt-get update/upgrade" before downloading the spyder. Otherwise, the spyder for python3.6 will be downloaded and cannot be used normally. For example, the python version of the spyder in Figure 1.2 is 3.6, indicating that the download has an error. .

2. If you don't see the compiler indicate that the installation process is wrong, try re-executing: **sudo apt-get update** and **sudo apt-get install spyder3**.

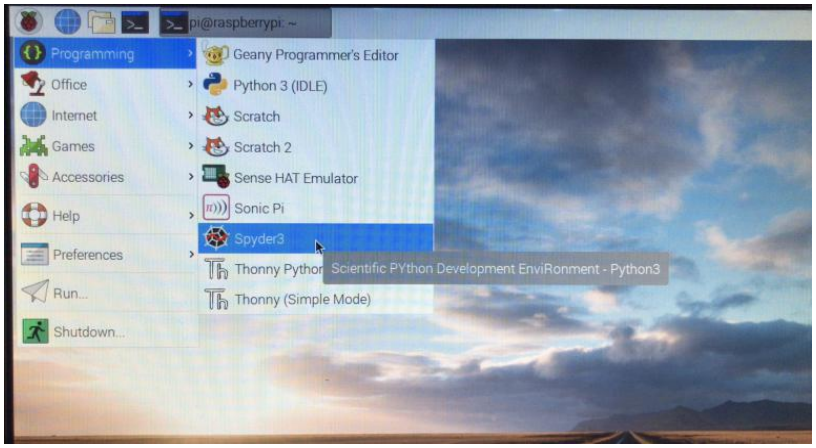


Figure 1-2

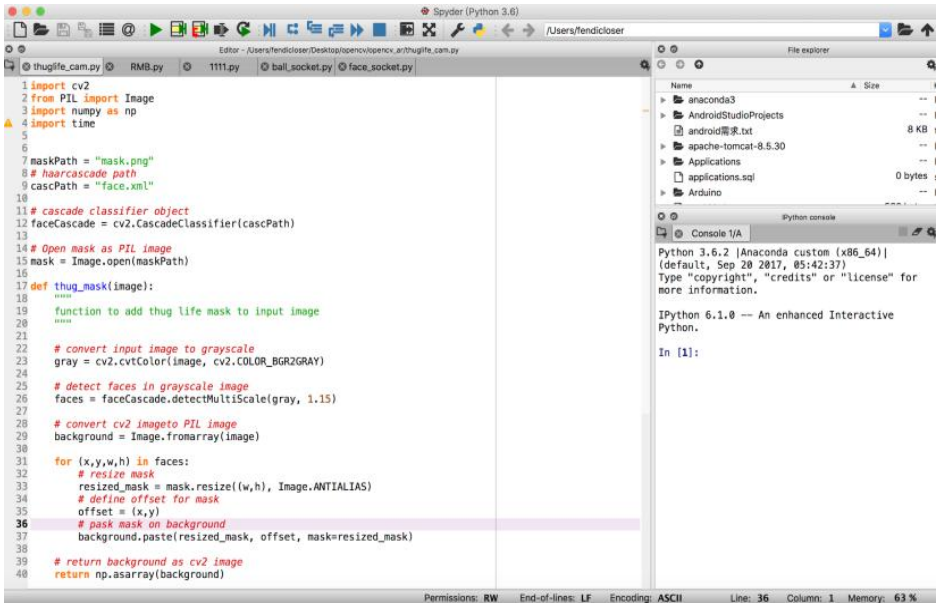


Figure 1-3　Python 3.6 version of Spyder3

1.2.2 set a static IP address of Raspberry Pi

1) In order to meet the usage environment of most people, we also modify eth0 and wlan0, which is wired network connection and Wi-Fi.

First terminal input:

```
ifconfig
```

This command is to view the dynamic IP address assigned by the Raspberry Pi, as shown in Figure 1-4 below.

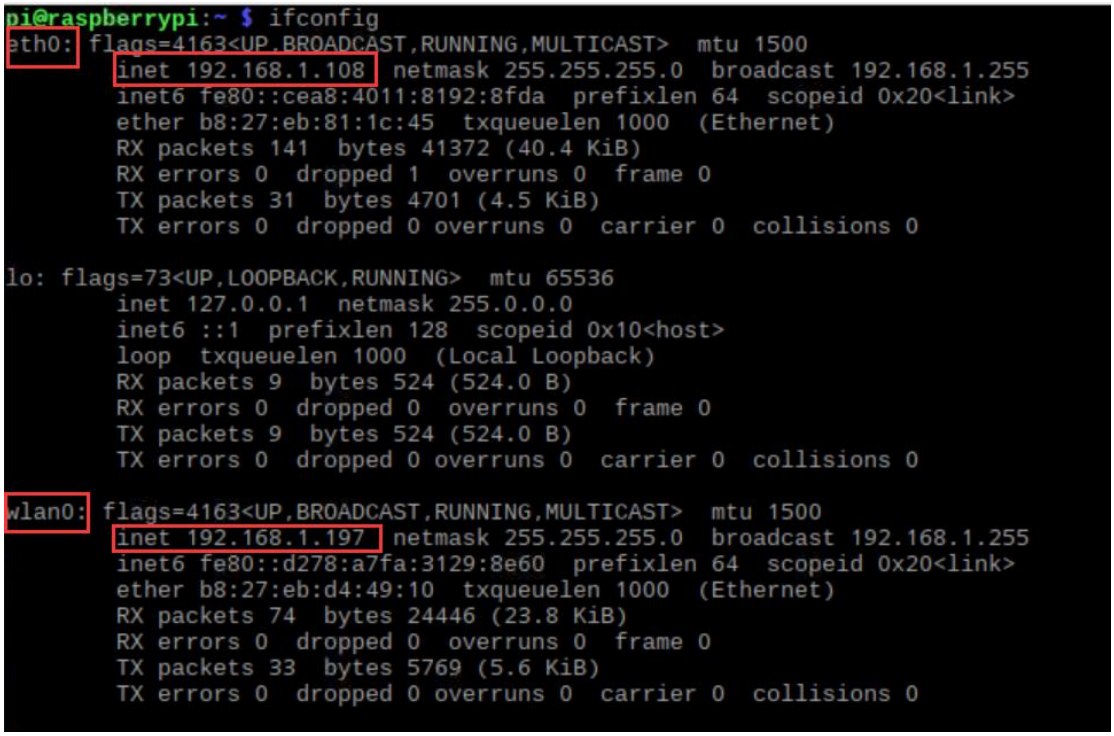


Figure 1-4

As shown, the author's eth0 address is 192.168.1.108 and the wlan0 address is 192.168.1.197.

(PS: Some user may have addresses of 192.168.0.xxx, 192.168.2.xxx or other case. Please record your address in advance.)

2) We need to input:

```
sudo nano /etc/dhcpcd.conf
```

After entering the file, find the two commands at the bottom of the file.

```
interface eth0

static ip_address=192.168.1.5/24
static routers=192.168.1.1
static domain_name_servers=192.168.1.1

interface wlan0

static ip_address=192.168.1.6/24
static routers=192.168.1.1
static domain_name_servers=192.168.1.1
```

eth0 and wlan0 do not conflict, you can also set both at the same time.

For example :my address is 192.168.1.xxx before modification, so the third bit of the static address is also set to "1". **About this, you must be set according to your actual situation.**

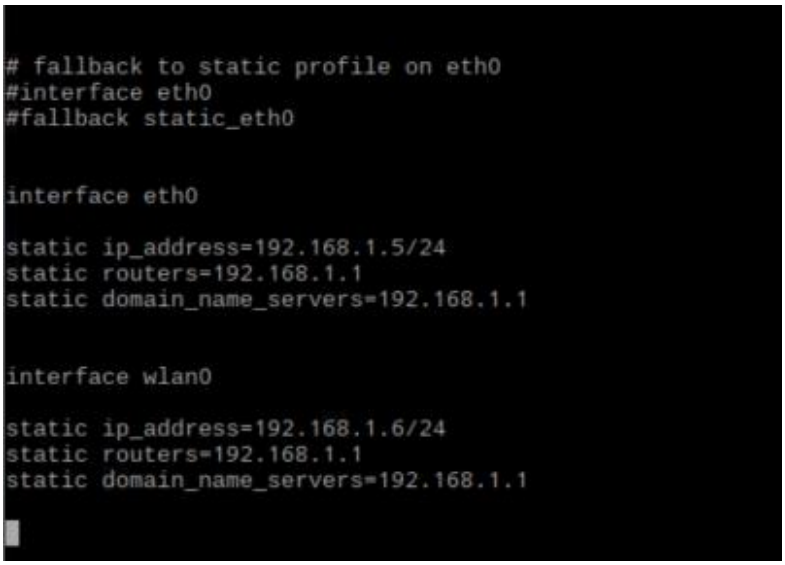


Figure 1-5 Modify the /ectdhcpcd.conf file

After the modification is completed, you need ot press ctrl+x , “y”, “enter”on the keyboard to save and exit the file.

Restart the Raspberry Pi. You will find that the IP address has changed by using the "ifconfig" command on the terminal again.

We can input ping www.baidu.com to see if we can access the Internet, as shown in Figure 1-6 below.

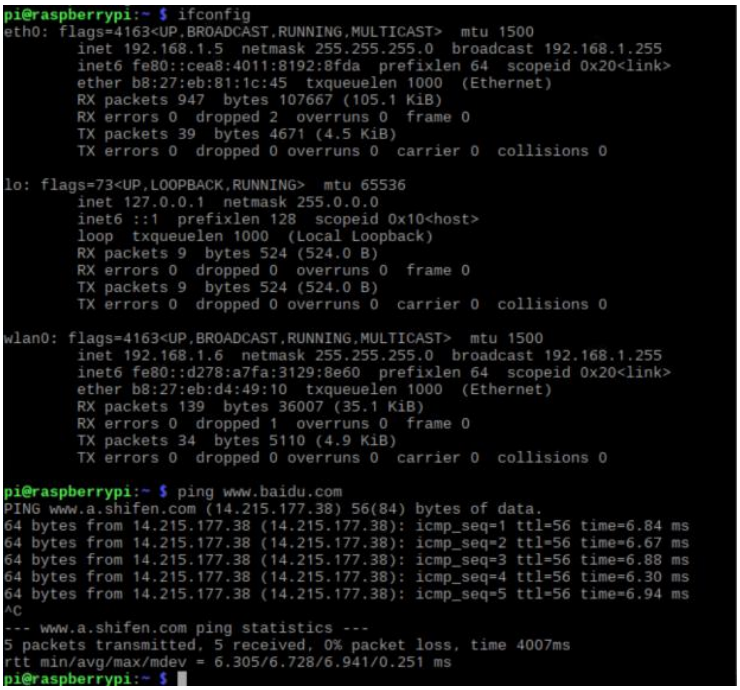


Figure 1-6

1.2.3 install python-opencv

1)We need to input :

```
sudo apt-get update
sudo apt-get upgrade
```

This command is to update Raspberry Pi system

2)We need to input:

```
sudo apt-get install libopencv-dev
sudo apt-get install python-opencv
```

This command isto install python-OpenCV

Note: This installation method does not know which version of OpenCV is installed, but our principle is to use version 2.4.9, which is compliant with the default download version of OpenCV.

Test whether OpenCV is successfully installed

Method1:

We can print the version number of OpenCV on the terminal command line. As shown in Figure 1-7 below.

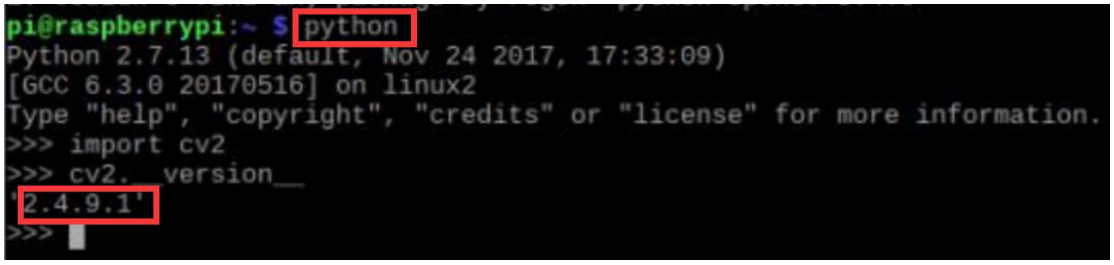
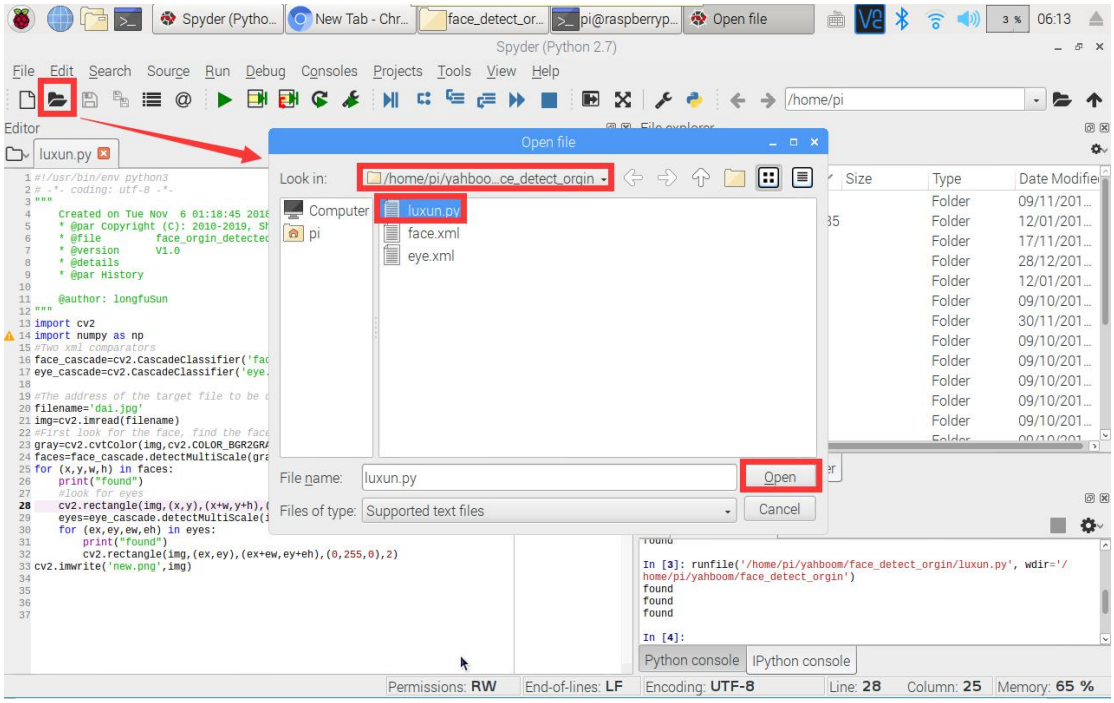


Figure 1-7

Method 2:

You need to enter '/home/pi/yahboom/face_detect_orgin' ,and open luxun.py. As shown in Figure 1-8 below.



This is a test code for faces and human eyes in pictures. The complete code is as follows:

```
#!/usr/bin/env python3
# -*- coding: utf-8 -*-
"""
    Created on Tue Nov  6 01:18:45 2018
    * @par Copyright (C): 2010-2019, Shenzhen Yahboom Tech
    * @file          face_orgin_detected
    * @version       V1.0
    * @details
    * @par History

    @author: longfuSun
"""
import cv2
import numpy as np
#Two xml comparators
face_cascade=cv2.CascadeClassifier('face.xml')
eye_cascade=cv2.CascadeClassifier('eye.xml')

#The address of the target file to be queried
filename='dai.jpg'
img=cv2.imread(filename)
#First look for the face, find the face rectangle
gray=cv2.cvtColor(img,cv2.COLOR_BGR2GRAY)
faces=face_cascade.detectMultiScale(gray,1.3,5)
for (x,y,w,h) in faces:
    print("found")
    #look for eyes
    cv2.rectangle(img,(x,y),(x+w,y+h),(255,0,0),2)
    eyes=eye_cascade.detectMultiScale(img)
    for (ex,ey,ew,eh) in eyes:
        print("found")
        cv2.rectangle(img,(ex,ey),(ex+ew,ey+eh),(0,255,0),2)
cv2.imwrite('new.png',img)
```

Two Methods to run a program:

Method 1: click the green triangle in the control bar. As shown in Figure 1- 9 below.

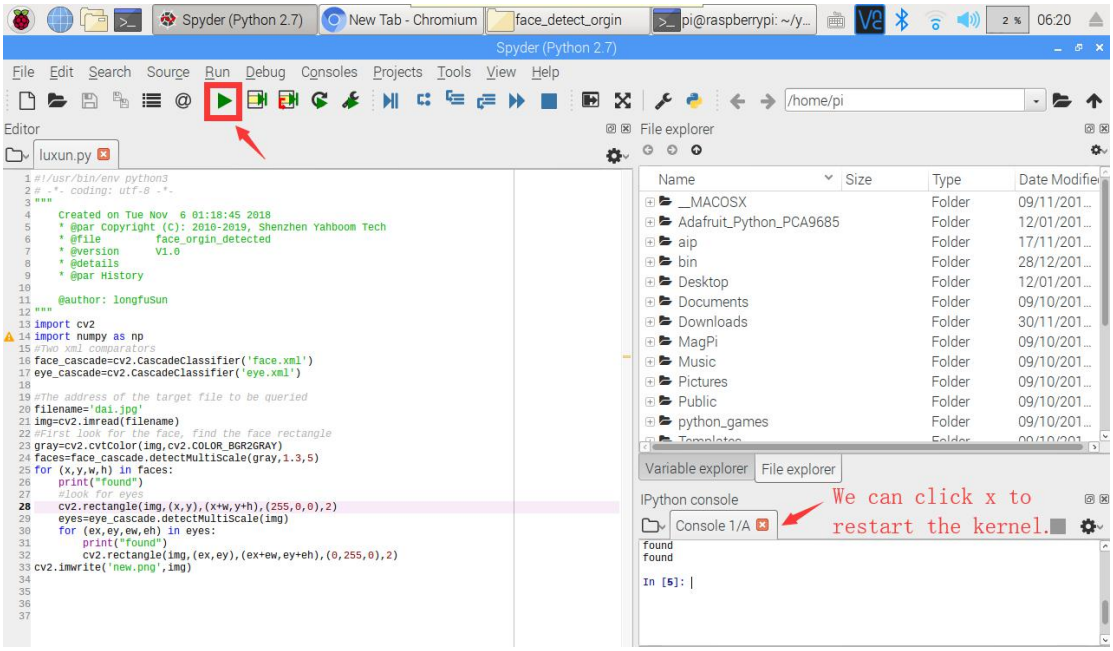


Figure 1- 9

Method 2: In the command terminal enter :

python + name of program

(for example:python luxun.py)

As shown in Figure 1- 10 below.

Figure 1- 10

Note: The code is OpenCV3, which is different from the version on the Raspberry Pi. OpenCV3 has been adjusted in many details with OpenCV2. Therefore, in the process of learning this project, it must be remembered that the version **on the Raspberry Pi is OpenCV2, on the computer is OpenCV3**. In the experiment, you may encounter: the code can be run on the PC, but report errors on the Raspberry Pi. In this case, please check the version of your code first.