

## Installation of OpenCV on Raspberry Pi 3

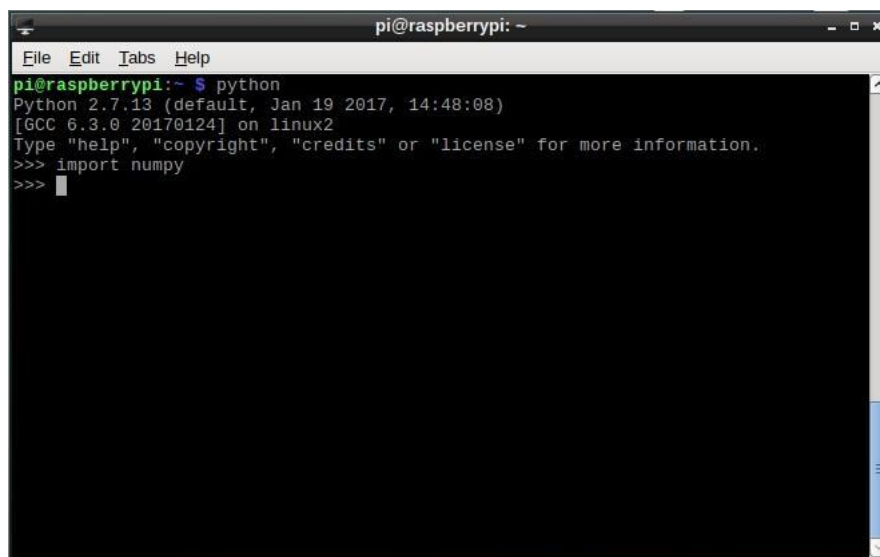
You will require to install some software for Image and Video Processing on the Raspberry Pi 3(RPi3). These need to be open source software to perform your tasks for eYRC-2017. As you have gained familiarity with 3 open source software in Task 0 and Task 1 viz. OpenCV, Python and Numpy, we will continue to use the same software just on a new OS i.e. the Raspbian OS on the RPi3. You may add other compatible open source Python based software at this point like Matplotlib, Scipy, imutils, PIL, etc. However, if you choose to add these new software and test your codes then please ensure you disclose the same to e-Yantra with your team ID.

In this document we will discuss the installation of the required software i.e. OpenCV on the RPi3. Before we begin to do so, please note there is a long list of steps and procedure of installing dependencies, for the OpenCV, first.

**Note:** Python 2.7 and Numpy exists on the Raspbian OS so you don't need to install them.

OpenCV 3.3.1 documentation can be found at the [link](#).

Please verify your version of python is Python 2.7.13 and Numpy is 1.12.1 by typing the command – *python* on the terminal of RPi3, as shown in the Figure 1. below:



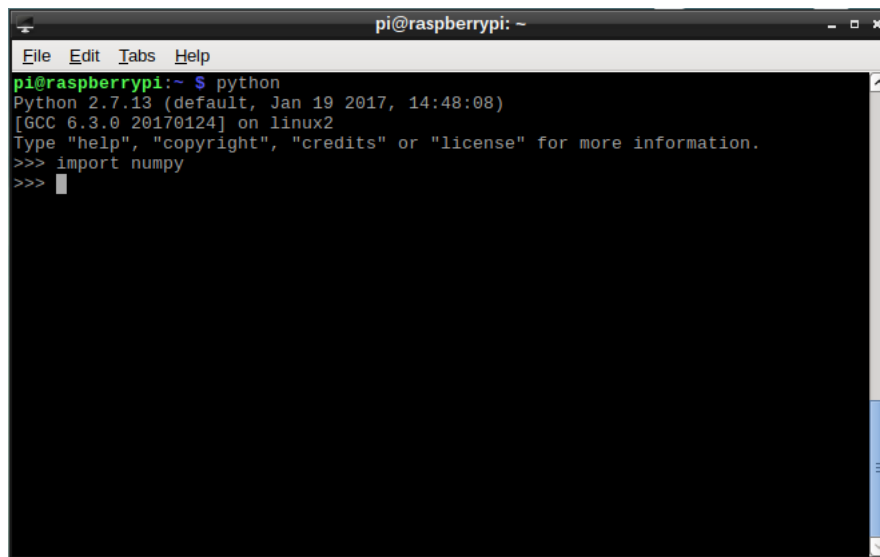
```
pi@raspberrypi: ~  
File Edit Tabs Help  
pi@raspberrypi:~ $ python  
Python 2.7.13 (default, Jan 19 2017, 14:48:08)  
[GCC 6.3.0 20170124] on linux2  
Type "help", "copyright", "credits" or "license" for more information.  
>>> import numpy  
>>>
```

Figure 1. “python” command

Once in python shell, type the following commands in sequence to check the version of Numpy:

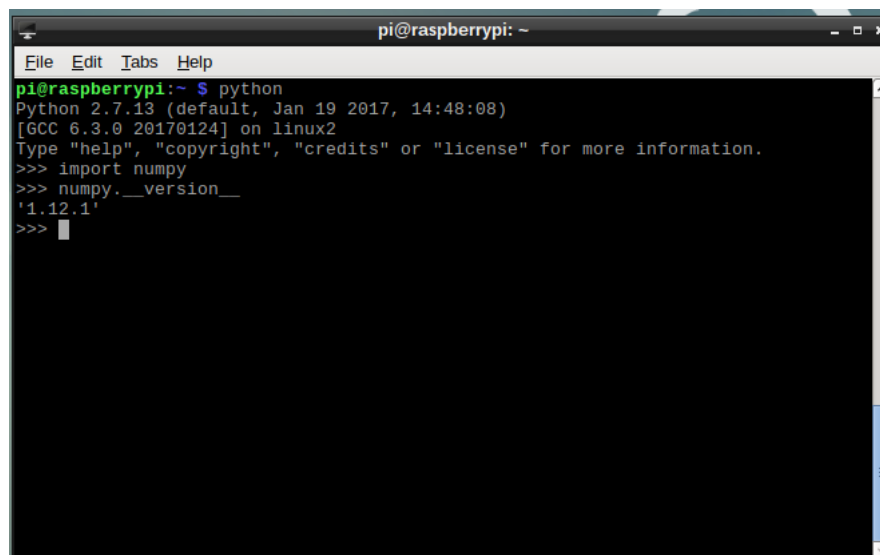
1. *import numpy*
2. *numpy.\_\_version\_\_*

as shown in the Figure 2. and Figure 3. below:



```
pi@raspberrypi: ~  
File Edit Tabs Help  
pi@raspberrypi:~ $ python  
Python 2.7.13 (default, Jan 19 2017, 14:48:08)  
[GCC 6.3.0 20170124] on linux2  
Type "help", "copyright", "credits" or "license" for more information.  
>>> import numpy  
>>> 
```

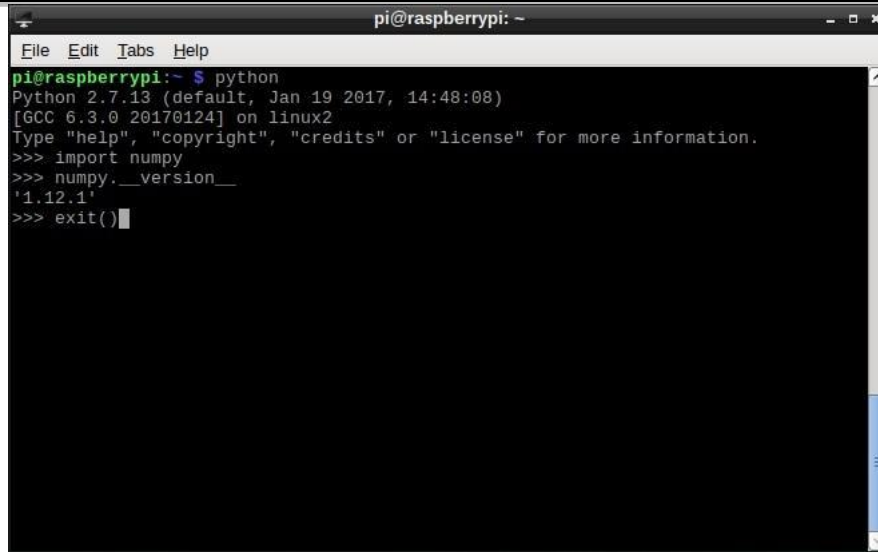
Figure 2. “import numpy” command



```
pi@raspberrypi: ~  
File Edit Tabs Help  
pi@raspberrypi:~ $ python  
Python 2.7.13 (default, Jan 19 2017, 14:48:08)  
[GCC 6.3.0 20170124] on linux2  
Type "help", "copyright", "credits" or "license" for more information.  
>>> import numpy  
>>> numpy.__version__  
'1.12.1'  
>>> 
```

Figure 3. “numpy.\_\_version\_\_” command

To exit the python shell to do further steps of installing OpenCV, please type the command – *exit()* [word exit including the parentheses].



```

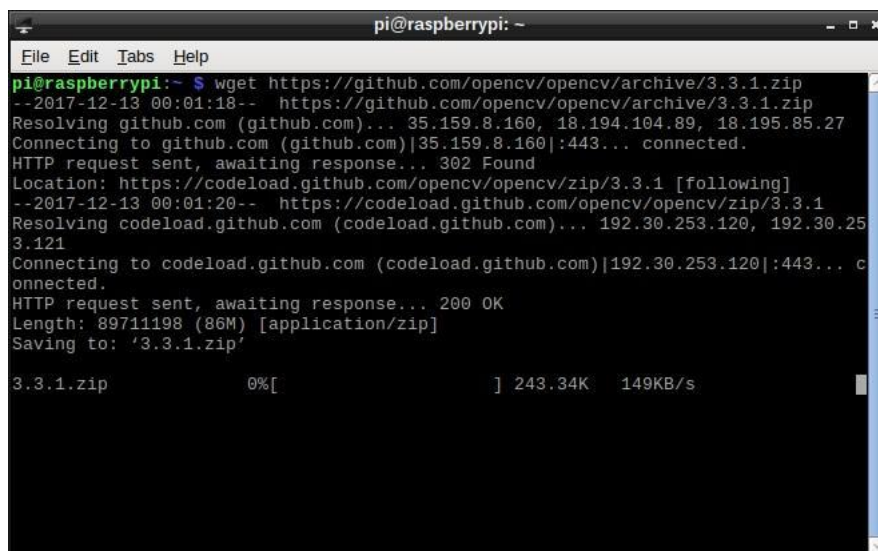
pi@raspberrypi: ~
File Edit Tabs Help
pi@raspberrypi:~$ python
Python 2.7.13 (default, Jan 19 2017, 14:48:08)
[GCC 6.3.0 20170124] on linux2
Type "help", "copyright", "credits" or "license" for more information.
>>> import numpy
>>> numpy.__version__
'1.12.1'
>>> exit()

```

Figure 4. “exit()” command

**Note:** During all installations if you are asked a question of the format [Y/n], then you must enter Y.

To install OpenCV on RPi 3, we need to download its source as a zip from the github repo. Since we are using a new install of Raspbian, we are going to install the latest version of OpenCV on it which is version 3.3.1. We will download the source zip of OpenCV using “wget” command from the following url- <https://github.com/opencv/opencv/archive/3.3.1.zip>, as shown in the Figure 5. below:



```

pi@raspberrypi: ~
File Edit Tabs Help
pi@raspberrypi:~$ wget https://github.com/opencv/opencv/archive/3.3.1.zip
--2017-12-13 00:01:18-- https://github.com/opencv/opencv/archive/3.3.1.zip
Resolving github.com (github.com)... 35.159.8.160, 18.194.104.89, 18.195.85.27
Connecting to github.com (github.com)|35.159.8.160|:443... connected.
HTTP request sent, awaiting response... 302 Found
Location: https://codeload.github.com/opencv/opencv/zip/3.3.1 [following]
--2017-12-13 00:01:20-- https://codeload.github.com/opencv/opencv/zip/3.3.1
Resolving codeload.github.com (codeload.github.com)... 192.30.253.120, 192.30.253.121
Connecting to codeload.github.com (codeload.github.com)|192.30.253.120|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 89711198 (86M) [application/zip]
Saving to: '3.3.1.zip'

3.3.1.zip           0%[          ] 243.34K  149KB/s

```

Figure 5. OpenCV source zip download via wget

The progress is shown by an arrow progressing from left to right with the % of download completed as shown in Figure 6. below:

```

pi@raspberrypi: ~
File Edit Tabs Help
pi@raspberrypi:~ $ wget https://github.com/opencv/opencv/archive/3.3.1.zip
--2017-12-13 06:11:23-- https://github.com/opencv/opencv/archive/3.3.1.zip
Resolving github.com (github.com)... 18.195.85.27, 18.194.104.89, 35.159.8.160
Connecting to github.com (github.com)|18.195.85.27|:443... connected.
HTTP request sent, awaiting response... 302 Found
Location: https://codeload.github.com/opencv/opencv/zip/3.3.1 [following]
--2017-12-13 06:11:25-- https://codeload.github.com/opencv/opencv/zip/3.3.1
Resolving codeload.github.com (codeload.github.com)... 192.30.253.120, 192.30.2
53.121
Connecting to codeload.github.com (codeload.github.com)|192.30.253.120|:443...
connected.
HTTP request sent, awaiting response... 200 OK
Length: 89711198 (86M) [application/zip]
Saving to: '3.3.1.zip'

3.3.1.zip          52%[=====>          ] 44.86M  678KB/s  eta 80s

```

Figure 6. OpenCV download progress

You can verify that the OpenCV 3.3.1.zip had indeed downloaded by running a command- **ls -lrth** on the terminal, as shown in the Figure 7. below:

```

pi@raspberrypi: ~
File Edit Tabs Help
pi@raspberrypi:~ $ ls -lrth
total 86M
drwxr-xr-x 2 pi pi 4.0K Sep  7 15:45 python_games
drwxr-xr-x 5 pi pi 4.0K Sep  7 15:45 Documents
drwxr-xr-x 2 pi pi 4.0K Sep  7 16:12 Videos
drwxr-xr-x 2 pi pi 4.0K Sep  7 16:12 Templates
drwxr-xr-x 2 pi pi 4.0K Sep  7 16:12 Public
drwxr-xr-x 2 pi pi 4.0K Sep  7 16:12 Pictures
drwxr-xr-x 2 pi pi 4.0K Sep  7 16:12 Music
drwxr-xr-x 2 pi pi 4.0K Sep  7 16:12 Downloads
drwxr-xr-x 2 pi pi 4.0K Sep  7 16:12 Desktop
-rw-r--r-- 1 pi pi 86M Dec 13 06:14 3.3.1.zip
pi@raspberrypi:~ $

```

Figure 7. OpenCV zip downloaded

Next you must download extras for OpenCV called “OpenCV Contrib” using wget from the url- [https://github.com/opencv/opencv\\_contrib/archive/3.3.1.zip](https://github.com/opencv/opencv_contrib/archive/3.3.1.zip). Since the .zip of OpenCV and OpenCV contrib are both named the same i.e. 3.3.1.zip, you must rename this zip download with the help of a -O flag, minus sign followed by alphabet ‘O’ followed by space and the name of what you want to store the zip by i.e. opencv\_contrib.zip. This is shown in the Figure 8. below:

```

pi@raspberrypi: ~
File Edit Tabs Help
pi@raspberrypi:~ $ wget https://github.com/opencv/opencv_contrib/archive/3.3.1.zip
ip -O opencv_contrib.zip
--2017-12-15 16:21:30-- https://github.com/opencv/opencv_contrib/archive/3.3.1.
zip
Resolving github.com (github.com)... 192.30.253.113, 192.30.253.112, 64:ff9b::c0
1e:fd70, ...
Connecting to github.com (github.com)[192.30.253.113]:443... connected.
HTTP request sent, awaiting response... 302 Found
Location: https://codeload.github.com/opencv/opencv_contrib/zip/3.3.1 [following]
--2017-12-15 16:21:32-- https://codeload.github.com/opencv/opencv_contrib/zip/3
.3.1
Resolving codeload.github.com (codeload.github.com)... 192.30.253.120, 192.30.25
3.121, 64:ff9b::c01e:fd79, ...
Connecting to codeload.github.com (codeload.github.com)[192.30.253.120]:443... c
onected.
HTTP request sent, awaiting response...

```

Figure 8. OpenCV Contrib download using wget with different name

You can verify that the OpenCV Contrib 3.3.1.zip had indeed downloaded by running a command- **ls -lrth** on the terminal with the new name you gave it, as shown in the Figure 9. below:

```

pi@raspberrypi: ~
File Edit Tabs Help
connected.
HTTP request sent, awaiting response... 200 OK
Length: 56009053 (53M) [application/zip]
Saving to: 'opencv_contrib.zip'

opencv_contrib.zip 100%[=====] 53.41M 1.24MB/s in 46s

2017-12-15 16:22:20 (1.15 MB/s) - 'opencv_contrib.zip' saved [56009053/56009053]

pi@raspberrypi:~ $ ls -lrth
total 140M
drwxr-xr-x 2 pi pi 4.0K Sep 7 15:45 python_games
drwxr-xr-x 5 pi pi 4.0K Sep 7 15:45 Documents
drwxr-xr-x 2 pi pi 4.0K Sep 7 16:12 Videos
drwxr-xr-x 2 pi pi 4.0K Sep 7 16:12 Templates
drwxr-xr-x 2 pi pi 4.0K Sep 7 16:12 Public
drwxr-xr-x 2 pi pi 4.0K Sep 7 16:12 Pictures
drwxr-xr-x 2 pi pi 4.0K Sep 7 16:12 Music
drwxr-xr-x 2 pi pi 4.0K Sep 7 16:12 Downloads
drwxr-xr-x 2 pi pi 4.0K Sep 7 16:12 Desktop
-rw-r--r-- 1 pi pi 86M Dec 13 06:14 3.3.1.zip
drwxr-xr-x 13 pi pi 4.0K Dec 15 11:23 opencv-3.3.1
-rw-r--r-- 1 pi pi 54M Dec 15 16:22 opencv_contrib.zip
pi@raspberrypi:~ $ unzip opencv_contrib.zip

```

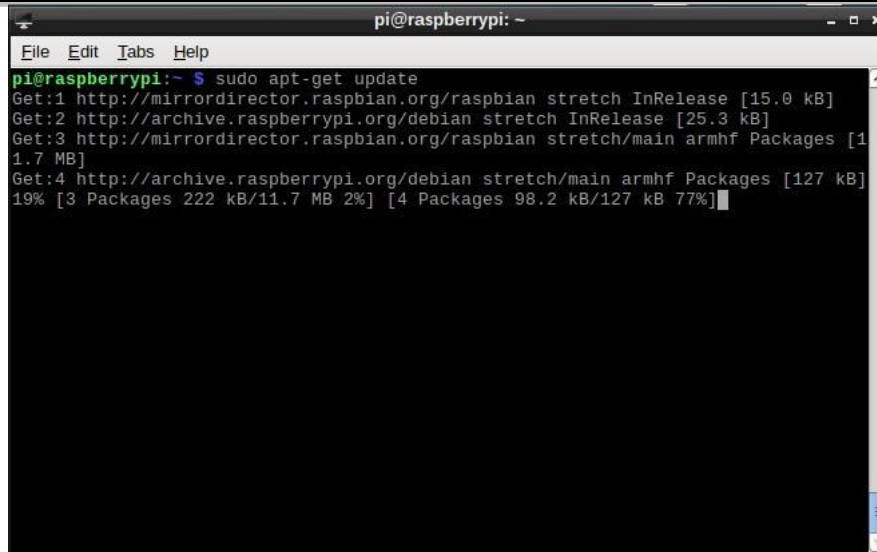
Figure 9. opencv\_contrib unzip command

Now unzip both the OpenCV and OpenCV Contrib zip folders using the command- **unzip 3.3.1.zip** and the command- **unzip opencv\_contrib.zip**, as shown in Figure 9. above.

Before installing the dependencies, it is advised updating and upgrading all the Raspbian software using the following commands:

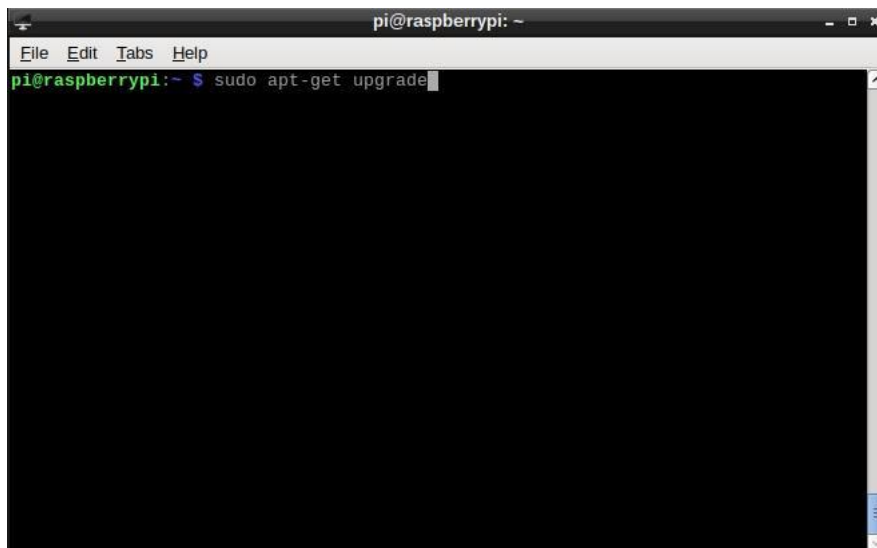
1. **sudo apt-get update**
2. **sudo apt-get upgrade**

as shown in the Figure 10. and 11. below:



```
pi@raspberrypi: ~  
File Edit Tabs Help  
pi@raspberrypi:~ $ sudo apt-get update  
Get:1 http://mirrordirector.raspbian.org/raspbian stretch InRelease [15.0 kB]  
Get:2 http://archive.raspberrypi.org/debian stretch InRelease [25.3 kB]  
Get:3 http://mirrordirector.raspbian.org/raspbian stretch/main armhf Packages [1  
1.7 MB]  
Get:4 http://archive.raspberrypi.org/debian stretch/main armhf Packages [127 kB]  
19% [3 Packages 222 kB/11.7 MB 2%] [4 Packages 98.2 kB/127 kB 77%]
```

Figure 10. update command



```
pi@raspberrypi: ~  
File Edit Tabs Help  
pi@raspberrypi:~ $ sudo apt-get upgrade
```

Figure 11. upgrade command

Now the next step is to install all dependencies for the Opencv3.3.1 version which can be done by ***sudo apt-get install*** of respective set of dependencies.

The first set of dependencies is of the libraries required to build the opencv from source using the command–

***sudo apt-get install build-essential cmake pkg-config***

as shown in the Figure 12. below:

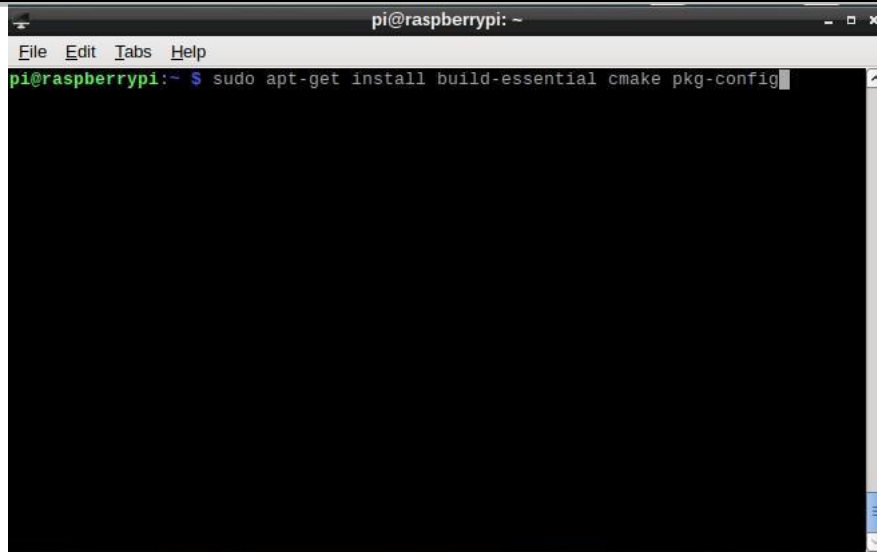


Figure 12. build libraries installation

The second set of dependencies is of the libraries required for the image format using the command—

***sudo apt-get install libjpeg-dev libtiff5-dev libjasper-dev libpng12-dev***

as shown in Figure 13. below:

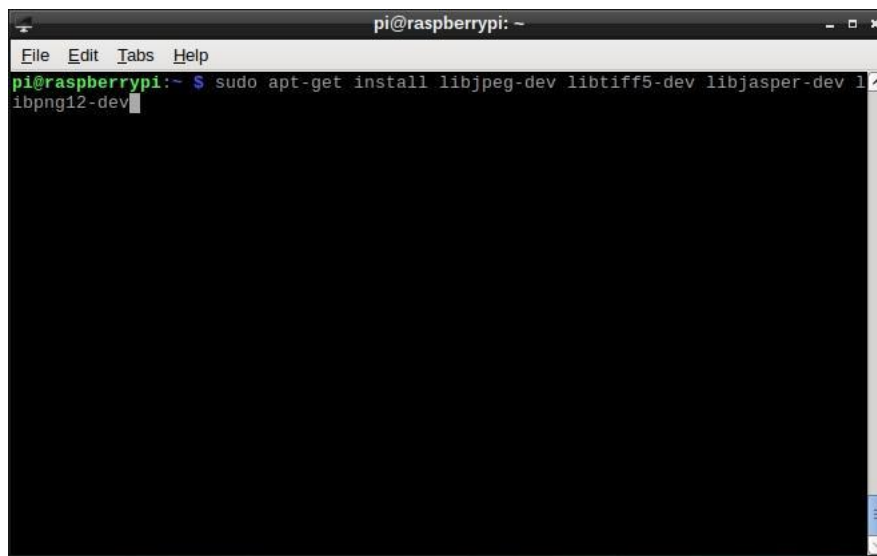


Figure 13. image format installation

The third set of dependencies is of the libraries required for the video codecs using the command—

***sudo apt-get install libavcodec-dev libavformat-dev libswscale-dev libv4l-dev***

As shown in Figure 14. below:



```

pi@raspberrypi: ~
File Edit Tabs Help
pi@raspberrypi:~$ sudo apt-get install libavcodec-dev libavformat-dev libswscale
e-dev libv4l-dev
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following package was automatically installed and is no longer required:
 libpng-tools
Use 'sudo apt autoremove' to remove it.
The following additional packages will be installed:
 libavcodec57 libavformat57 libavutil-dev libavutil55 libswresample-dev
 libswresample2 libswscale4
The following NEW packages will be installed:
 libavcodec-dev libavformat-dev libavutil-dev libswresample-dev
 libswscale-dev libv4l-dev
The following packages will be upgraded:
 libavcodec57 libavformat57 libavutil55 libswresample2 libswscale4
5 upgraded, 6 newly installed, 0 to remove and 155 not upgraded.
Need to get 6,346 kB/11.9 MB of archives.
After this operation, 21.1 MB of additional disk space will be used.
Do you want to continue? [Y/n] Y
48% [Connecting to mirror.ossplanet.net]

```

Figure 14. video codec installation

Second set of video codec dependencies are installed using the following command-  
***sudo apt-get install libxvidcore-dev libx264-dev***  
as shown in Figure 15. below:

```

pi@raspberrypi: ~
File Edit Tabs Help
Processing triggers for libc-bin (2.24-11+deb9u1) ...
pi@raspberrypi:~$ sudo apt-get install libxvidcore-dev libx264-dev
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following package was automatically installed and is no longer required:
 libpng-tools
Use 'sudo apt autoremove' to remove it.
The following NEW packages will be installed:
 libx264-dev libxvidcore-dev
0 upgraded, 2 newly installed, 0 to remove and 155 not upgraded.
Need to get 0 B/592 kB of archives.
After this operation, 1,722 kB of additional disk space will be used.
Selecting previously unselected package libx264-dev:armhf.
(Reading database ... 124991 files and directories currently installed.)
Preparing to unpack .../libx264-dev_2%3a0.148.2748+git97eae2-1+rp11_armhf.deb ...
Unpacking libx264-dev:armhf (2:0.148.2748+git97eae2-1+rp11) ...
Selecting previously unselected package libxvidcore-dev:armhf.
Preparing to unpack .../libxvidcore-dev_2%3a1.3.4-1_armhf.deb ...
Unpacking libxvidcore-dev:armhf (2:1.3.4-1) ...
Setting up libx264-dev:armhf (2:0.148.2748+git97eae2-1+rp11) ...
Setting up libxvidcore-dev:armhf (2:1.3.4-1) ...
pi@raspberrypi:~$

```

Figure 15. second set of video codec installation

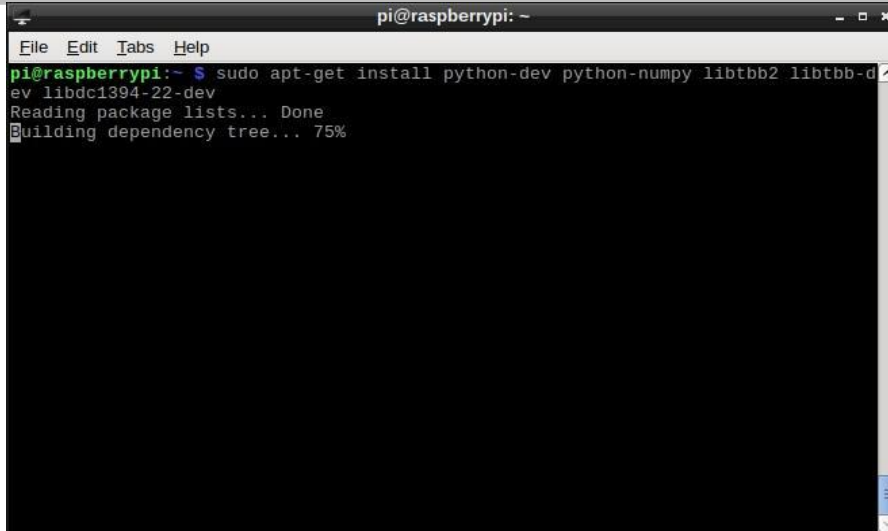
Other dependencies are gtk3 which can be installed by the following command-  
***sudo apt-get install libgtk-3-dev***

Next you have to install python development libraries and remaining dependencies with the command below-

***sudo apt-get install python-dev python-numpy libtbb2 libtbb-dev libdc1394-22-dev***

as shown in the Figure 17. below:





```

pi@raspberrypi: ~
File Edit Tabs Help
pi@raspberrypi:~$ sudo apt-get install python-dev python-numpy libtbb2 libtbb-d
ev libdc1394-22-dev
Reading package lists... Done
Building dependency tree... 75%

```

Figure 17. python development libraries installation

All the required dependencies have now been installed and you can go ahead and build OpenCV. Change your path to opencv-3.3.1 folder.

**Note:** Raspbian uses Linux style commands

So to change the directory type the command-

***cd opencv-3.3.1***

In this path make a new directory called “build” using the command-

***sudo mkdir build***

Now switch to the build folder by using command-

***cd build***

in this folder type the following cmake command to create the Makefile-

***sudo cmake -DCMAKE\_BUILD\_TYPE=RELEASE -DCMAKE\_INSTALL\_PREFIX=/usr/local  
-DINSTALL\_PYTHON\_EXAMPLES=ON -DBUILD\_EXAMPLES=ON  
-DOPENCV\_EXTRA\_MODULES\_PATH=~/opencv\_contrib-3.3.1/modules ..***

The above 3 lines are one command i.e. starting at sudo and ending at ..

This step and following steps will take significant time of processing, so be patient.

Next step is the execution of the following commands-

**1. *sudo make clean***

## 2. *sudo make*

```
pi@raspberrypi: ~/opencv-3.3.1/build
File Edit Tabs Help
CMakeFiles      downloads      samples
cmake_install.cmake  include      share
cmake_uninstall.cmake  junk        test-reports
CMakeVars.txt      lib          text_config.hpp
CPackConfig.cmake   Makefile     unix-install
CPackSourceConfig.cmake  modules     version_string.tmp
pi@raspberrypi:~/opencv-3.3.1/build $ make clean
pi@raspberrypi:~/opencv-3.3.1/build $ make
[ 0%] Generate opencv.pc
[ 0%] Built target gen-pkgconfig
[ 0%] Building C object 3rdparty/libwebp/CMakeFiles/libwebp.dir/dec/alpha_dec.c.o
[ 1%] Building C object 3rdparty/libwebp/CMakeFiles/libwebp.dir/dec/buffer_dec.c.o
[ 1%] Building C object 3rdparty/libwebp/CMakeFiles/libwebp.dir/dec/frame_dec.c.o
[ 1%] Building C object 3rdparty/libwebp/CMakeFiles/libwebp.dir/dec/idec_dec.c.o
[ 1%] Building C object 3rdparty/libwebp/CMakeFiles/libwebp.dir/dec/io_dec.c.o
[ 1%] Building C object 3rdparty/libwebp/CMakeFiles/libwebp.dir/dec/quant_dec.c.o
[ 1%] Building C object 3rdparty/libwebp/CMakeFiles/libwebp.dir/dec/tree_dec.c.o
[ 1%] Building C object 3rdparty/libwebp/CMakeFiles/libwebp.dir/dec/vp8_dec.c.o
[ 1%] Building C object 3rdparty/libwebp/CMakeFiles/libwebp.dir/dec/vp8l_dec.c.o
```

*sudo make* command will take a while to execute (approximately 2-3 hours)

```
pi@raspberrypi: ~/opencv-3.3.1/build
File Edit Tabs Help
[100%] Building CXX object samples/tapi/CMakeFiles/example_tapi_clahe.dir/clahe.cpp.o
[100%] Linking CXX executable ../../bin/tapi-example-clahe
[100%] Built target example_tapi_clahe
[100%] Building CXX object samples/tapi/CMakeFiles/example_tapi_pyrlk_optical_flow.dir/pyrlk_optical_flow.cpp.o
[100%] Linking CXX executable ../../bin/tapi-example-pyrlk_optical_flow
[100%] Built target example_tapi_pyrlk_optical_flow
[100%] Building CXX object samples/tapi/CMakeFiles/example_tapi_bgfg_segm.dir/bgfg_segm.cpp.o
[100%] Linking CXX executable ../../bin/tapi-example-bgfg_segm
[100%] Built target example_tapi_bgfg_segm
[100%] Building CXX object samples/tapi/CMakeFiles/example_tapi_camshift.dir/camshift.cpp.o
[100%] Linking CXX executable ../../bin/tapi-example-camshift
[100%] Built target example_tapi_camshift
[100%] Building CXX object samples/tapi/CMakeFiles/example_tapi_tv11_optical_flow.dir/tv11_optical_flow.cpp.o
[100%] Linking CXX executable ../../bin/tapi-example-tv11_optical_flow
[100%] Built target example_tapi_tv11_optical_flow
[100%] Building CXX object samples/tapi/CMakeFiles/example_tapi_squares.dir/squares.cpp.o
[100%] Linking CXX executable ../../bin/tapi-example-squares
[100%] Built target example_tapi_squares
[100%] Building CXX object samples/tapi/CMakeFiles/example_tapi_ufacedetect.dir/ufacedetect.cpp.o
[100%] Linking CXX executable ../../bin/tapi-example-ufacedetect
[100%] Built target example_tapi_ufacedetect
pi@raspberrypi:~/opencv-3.3.1/build $
```

### 3. *sudo make install*

```

pi@raspberrypi: ~/opencv-3.3.1/build
File Edit Tabs Help
[100%] Built target example_tapi_tv11_optical_flow
[100%] Building CXX object samples/tapi/CMakeFiles/example_tapi_squares.dir/squares.cpp.o
[100%] Linking CXX executable ../../bin/tapi-example-squares
[100%] Built target example_tapi_squares
[100%] Building CXX object samples/tapi/CMakeFiles/example_tapi_ufacedetect.dir/ufacedetect.cpp.o
[100%] Linking CXX executable ../../bin/tapi-example-ufacedetect
[100%] Built target example_tapi_ufacedetect
pi@raspberrypi:~/opencv-3.3.1/build $ make install
[ 0%] Built target gen-pkgconfig
[ 5%] Built target libwebp
[ 8%] Built target IlmImf
[10%] Built target carotene_objs
[11%] Built target tegra_hal
[13%] Built target libprotobuf
[13%] Built target opencv_ts_pch_dephelp
[13%] Built target pch_Generate_opencv_ts
[13%] Built target opencv_core_pch_dephelp
[13%] Built target pch_Generate_opencv_core
[15%] Built target opencv_core
[15%] Built target opencv_imgproc_pch_dephelp
[15%] Built target pch_Generate_opencv_imgproc
[17%] Built target opencv_imgproc
[17%] Built target opencv_imgcodecs_pch_dephelp

```

### 4. *sudo ldconfig*

```

pi@raspberrypi: ~/opencv-3.3.1/build
File Edit Tabs Help
-- Installing: /usr/local/share/OpenCV/samples/python/letter_recog.py
-- Installing: /usr/local/share/OpenCV/samples/python/lk_homography.py
-- Installing: /usr/local/share/OpenCV/samples/python/lk_track.py
-- Installing: /usr/local/share/OpenCV/samples/python/logpolar.py
-- Installing: /usr/local/share/OpenCV/samples/python/morphology.py
-- Installing: /usr/local/share/OpenCV/samples/python/mosse.py
-- Installing: /usr/local/share/OpenCV/samples/python/mouse_and_match.py
-- Installing: /usr/local/share/OpenCV/samples/python/mser.py
-- Installing: /usr/local/share/OpenCV/samples/python/opencv_version.py
-- Installing: /usr/local/share/OpenCV/samples/python/opt_flow.py
-- Installing: /usr/local/share/OpenCV/samples/python/peopledetect.py
-- Installing: /usr/local/share/OpenCV/samples/python/plane_ar.py
-- Installing: /usr/local/share/OpenCV/samples/python/plane_tracker.py
-- Installing: /usr/local/share/OpenCV/samples/python/squares.py
-- Installing: /usr/local/share/OpenCV/samples/python/stereo_match.py
-- Installing: /usr/local/share/OpenCV/samples/python/texture_flow.py
-- Installing: /usr/local/share/OpenCV/samples/python/tst_scene_render.py
-- Installing: /usr/local/share/OpenCV/samples/python/turing.py
-- Installing: /usr/local/share/OpenCV/samples/python/video.py
-- Installing: /usr/local/share/OpenCV/samples/python/video_threaded.py
-- Installing: /usr/local/share/OpenCV/samples/python/video_v4l2.py
-- Installing: /usr/local/share/OpenCV/samples/python/watershed.py
pi@raspberrypi:~/opencv-3.3.1/build $ sudo ldconfig
pi@raspberrypi:~/opencv-3.3.1/build $

```

This successfully completes the installation of OpenCV on Raspbian OS.