Beginners Guide to start using Raspberry Pi with OpenCV

1. Download SD card formatter here, https://www.sdcard.org/downloads/
2. Insert the SD card to the computer and format SD card using the formatter
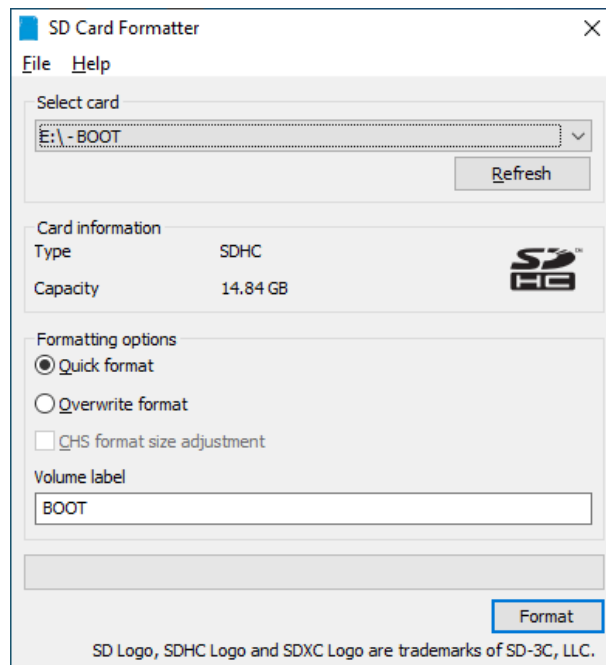

3. Download Raspberry Pi Imager here, https://www.raspberrypi.com/software/
4. Open the Imager, choose the options as below and upload Raspberry Pi OS to the SD card
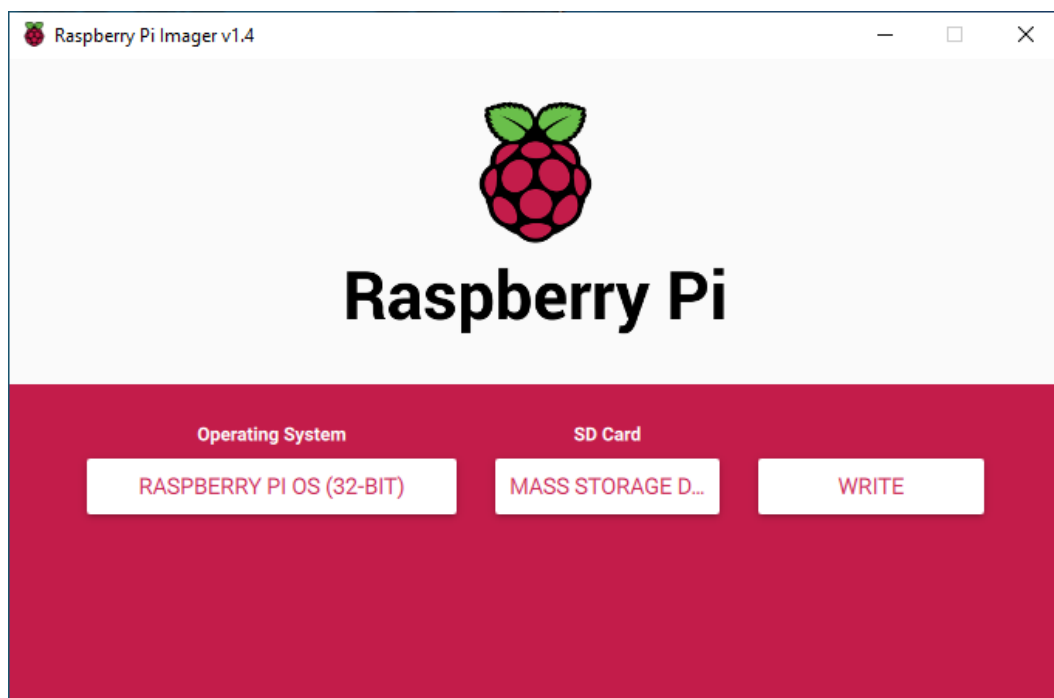
5. When finished writing image to SD card, do not remove the SD card yet.

6. For headless setup
   - Configure wireless network
     - Go to Boot folder. For Windows, make sure to tick "File name extensions" in View tab. Then, right click, select New > Text Document.
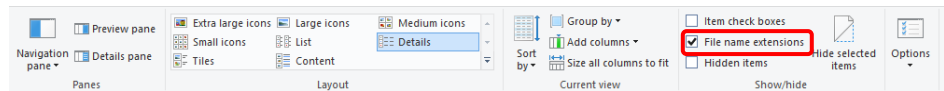
     - Rename the file to "wpa_supplicant.conf". Make sure the file type is "CONF File" instead of "Text Document".
     - Open the file using Notepad++. Copy text below and paste into the file.

```
ctrl_interface=DIR=/var/run/wpa_supplicant GROUP=netdev
country=<Insert 2 letter ISO 3166-1 country code here>
update_config=1

network={
 ssid="<Name of your wireless LAN>"
 psk="<Password for your wireless LAN>"
}
```

     - Change the text highlighted in yellow to your own preference, eg.:

```
ctrl_interface=DIR=/var/run/wpa_supplicant GROUP=netdev
country=MY
update_config=1

network={
 ssid="Rpi_Hotspot"
 psk="abcd1234"
}
```

   - Enabling SSH
     - Create SSH file named "ssh" without any extension into the Boot folder and leave it blank.
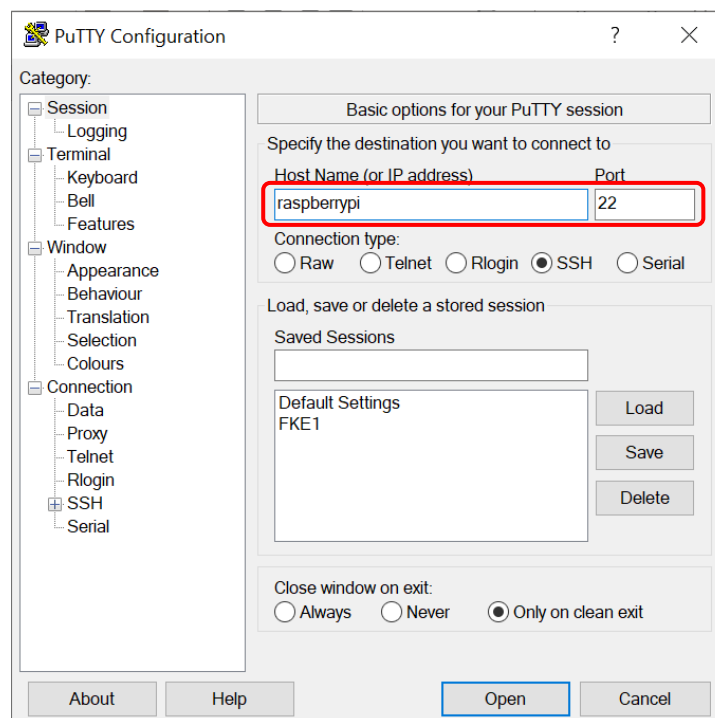   - Finally, you should have 2 new files in the Boot folder.

- o   Remove SD card from computer

- Connect to Raspberry Pi using SSH (using command line)
  - o   Download and install PuTTY in your remote desktop, https://www.putty.org/
  - o   Insert the SD card and power on your Raspberry Pi
  - o   Open PuTTY and write in as below

- o Enter default username and password
    - login as: pi
    - password: raspberry
- Install VNC (to access full desktop environment)
    - o sudo apt update
    - o sudo apt install realvnc-vnc-server realvnc-vnc-viewer
- Enabling VNC Server
    - o sudo raspi-config
    - o Navigate to Interface Options > VNC > Yes
    - o Then select Finish
- Connecting to Raspberry Pi desktop
    - o Download VNC Viewer in the remote desktop
    - o On SSH terminal, run "ifconfig" to discover your private IP address

```
pi@raspberrypi: ~                                                    —   □   ✕

SSH is enabled and the default password for the 'pi' user has not been changed.
This is a security risk - please login as the 'pi' user and type 'passwd' to set
 a new password.

pi@raspberrypi:~ $ ifconfig
eth0: flags=4099<UP,BROADCAST,MULTICAST>  mtu 1500
        ether b8:27:eb:48:8c:14  txqueuelen 1000  (Ethernet)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 31  bytes 2960 (2.8 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 31  bytes 2960 (2.8 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

wlan0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.186.1  netmask 255.255.255.0  broadcast 192.168.186.255
        inet6 2001:d08:2283:6aaf:8ab:762d:ea35:17d1  prefixlen 64  scopeid 0x0<g
lobal>
        inet6 fe80::4a0b:a4be:1620:9b32  prefixlen 64  scopeid 0x20<link>
        ether b8:27:eb:1d:d9:41  txqueuelen 1000  (Ethernet)
        RX packets 2511  bytes 2713505 (2.5 MiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 1536  bytes 228523 (223.1 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

- o Enter your Raspberry Pi's private IP address into VNC Viewer
- o Done!

7. To install OpenCV, open terminal, then follow steps below:
    - sudo apt-get update
    - sudo apt-get upgrade
    - pip3 install --upgrade pip
    - sudo pip3 install numpy
    - sudo pip3 install scipy

- sudo pip3 install scikit-image
- sudo pip3 install RPi.GPIO
- sudo apt-get install build-essential cmake unzip pkg-config
- sudo apt-get install libjpeg-dev libpng-dev libtiff-dev
- sudo apt-get install libavcodec-dev libavformat-dev libswscale-dev libv4l-dev
- sudo apt-get install libxvidcore-dev libx264-dev
- sudo apt-get install libgtk-3-dev
- sudo apt-get install libcanberra-gtk*
- sudo apt-get install libatlas-base-dev gfortran
- sudo apt-get install python3-dev
- sudo apt-get install python3-opencv
- sudo apt-get install idle3
- sudo idle
- In IDLE, type in:
  ```
  import cv2
  print(cv2.__version__)
  ```
- If OpenCV version is successfully print out, then the package is successfully installed

8. Enable camera

   To do this, enter `sudo raspi-config` at a terminal window and then choose `Interface Options`, `Camera` and `Yes`.

9. Enable Glamor

   On Pi3 and earlier devices running **Bullseye** you need to re-enable *Glamor* in order to make the X-Windows hardware accelerated preview window work. To do this at the configuration window, choose `Advanced Options`, `Glamor` and `Yes`. Finally quit `raspi-config` and let it reboot your Pi.

10. To test your camera, open terminal, then type in:
    ```
    libcamera-hello    (for Bullseye)
    or
    raspistill -o Desktop/image.jpg
    ```

11. Try the code in Python 3 IDE:
    ```python
    import cv2

    # define a video capture object
    vid = cv2.VideoCapture(0)

    while(True):
    ```

```python
    # Capture the video frame by frame
    ret, frame = vid.read()

    # Display the resulting frame
    cv2.imshow('frame', frame)

    # the 'q' button is set as the
    # quitting button you may use any
    # desired button of your choice
    if cv2.waitKey(1) & 0xFF == ord('q'):
        break

# After the loop release the cap object
vid.release()
# Destroy all the windows
cv2.destroyAllWindows()
```