OpenCV for Computer Vision

Note that the only Perception Sensor of our PiCar is a USB webcam. A webcam gives us a live video, which is essentially a sequence of pictures. We will use OpenCV, a powerful open source computer vision library, to capture and transform these pictures so that we can make sense of what the camera is seeing. Run the following commands to install it on your Pi.

Install Open CV and Related Libraries

```
# install all dependent libraries of OpenCV (yes, this is one long command)
pi@raspberrypi:~ $ sudo apt-get install libhdf5-dev -y && sudo apt-get install libhdf5-serial-dev -y && sudo apt-get install libatlas-base-dev -y && sudo apt-get install libjasper-dev -y && sudo apt-get install libqtgui4 -y && sudo apt-get install libqt4-test -y
# install OpenCV and other libraries
pi@raspberrypi:~ $ pip3 install opencv-python==3.4.4.19
Collecting opencv-python
[Omitted....]
Installing collected packages: numpy, opencv-python
Successfully installed numpy-1.16.2 opencv-python-3.4.4.19
pi@raspberrypi:~ $ pip3 install matplotlib
Collecting matplotlib
Collecting pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.1 (from matplotlib)
[Omitted...]
Successfully installed cycler-0.10.0 kiwisolver-1.1.0 matplotlib-3.0.3 numpy-1.16.3 pyparsing-2.4.0 python-dateutil-2.8.0 setuptools-41.0.1 six-1.12.0
```

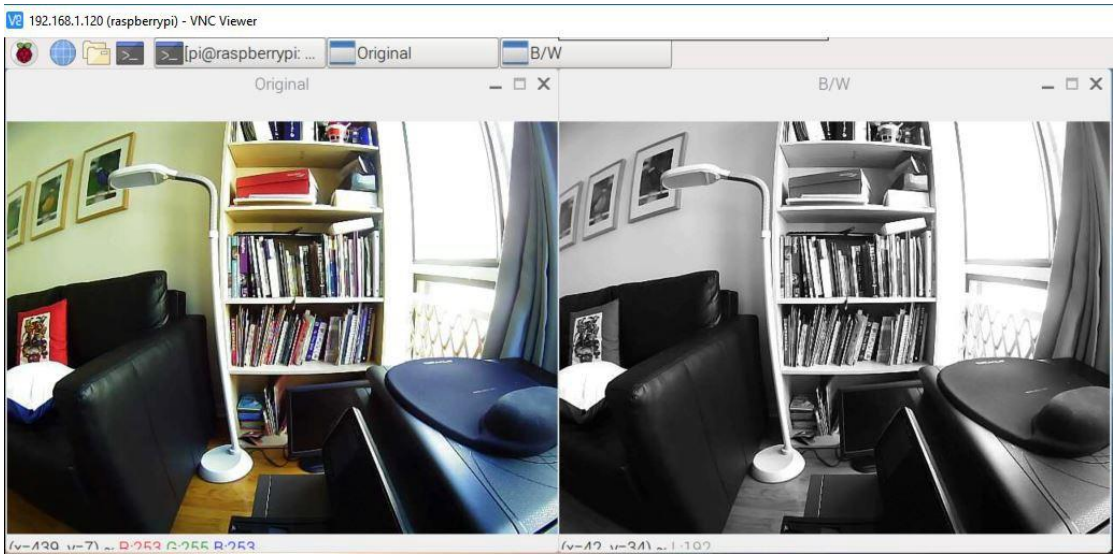
Test OpenCV Installation

Here are the most basic tests to see if our python libraries are installed. The Python module name for OpenCV is `cv2`. If you don't see any error when running the following commands, then the modules should be installed correctly. Numpy and Matplotlib are two very useful python modules that we will use in conjunction with OpenCV for image processing and rendering.

```
pi@raspberrypi:~ $ python3 -c "import cv2"
pi@raspberrypi:~ $ python3 -c "import numpy"
pi@raspberrypi:~ $ python3 -c "import matplotlib"
```

Ok, let's try to some live video processing!

```
pi@raspberrypi:~ $ cd
pi@raspberrypi:~ $ git clone https://github.com/dctian/DeepPiCar.git
Cloning into 'DeepPiCar'...
remote: Enumerating objects: 482, done.
[Omitted...]
Resolving deltas: 100% (185/185), done.
pi@raspberrypi:~ $ cd DeepPiCar/driver/code
pi@raspberrypi:~ $ python3 opencv_test.py
```



If you see two live video screens, one colored and one black/white, then your OpenCV is working! Press `q` to quit the test. Essentially, the program takes the images captured from the camera and displays it as is (the Original window), and then it converts the image to a black and white image (the B/W window).