CLASS 1 NOTES - THE RASPBERRY PI 2 (RaPi)

INTRODUCTION

The Linux Dstribution

In the interest of time, the Raspberry Pi 2 Model B has been pre-configured with a working copy of Raspian-Wheesy (the operating system based on Linux Debian) and the OpenCV and a custom Python environments are already installed.   Installing the OS and OpenCV from scratch would take far longer than the time available for the first class, and would detract from the main thrust of the class, to provide an environment for sensing on the Arduino and Raspberry Pi.

Accessing the RaPi2

There are three common ways to work with the RaPi2:

1. Using a keyboard, mouse (touchpad) and monitor (HDMI) - note there are HDMI->VGA adaptors available.
2. Connecting to an external computer (PC or laptop) via an ethernet cable
3. Connecting to an external computer via WiFi

Each of these have their advantages and disadvantages.

What we Did to get a Raspberry Pi 2 Boot Disk

The procedure we followed to create your boot disk with OpenCV is the following:

1. We created a Raspbian boot disk from the disk image 2015-05-05-raspbian-wheezy.img (See Appendix A1)
2. We followed the procedure in the link below to install OpenCV

http://www.pyimagesearch.com/2015/02/23/install-opencv-and-python-on-your-raspberry-pi-2-and-b/

Note that for this class it is not necessary for the students to carry out this procedure, since we have done the heavy lifting prior to the class, and carrying out these steps takes many many hour. The first time it took one of us a couple of days to get this right.

Creating a Backup Boot Disk for the Raspberry Pi 2

We recommend that you purchase a spare micro-SD card (8 GB) and create a backup boot disk (see Appendix A2). The procedure for creating this disk with the requisite boot image is described in Appendix A1.

Booting up the Raspberry Pi 2 for First Time (Direct Connection)

Do the following:
1. Make sure there is a micro-SD boot disk with Raspbian installed, mounted in the micro-SD slot
2. Connect a mouse and a keyboard to the Raspberry Pi 2
3. Connect a suitable HDMI monitor (or a TV)
4. Plug in power; you should see the unit boot up; it will boot into the user space.

Communicating with the RaPi from Laptop

If you know the IP address of the RaPi by one of the following means:
1. You have given it a static IP address as described in Appendix A3
2. It is configured for DHCP and you are on a network and you have determined it's IP address by some other means.

then it is possible to access directly as described in Appendix A4.

Mounting the Camera

This should be done with the unit powered down.

Username and Password

Username: pi
Password: r2
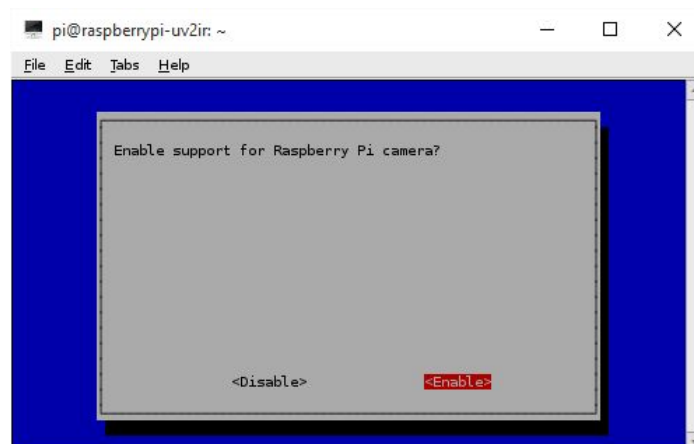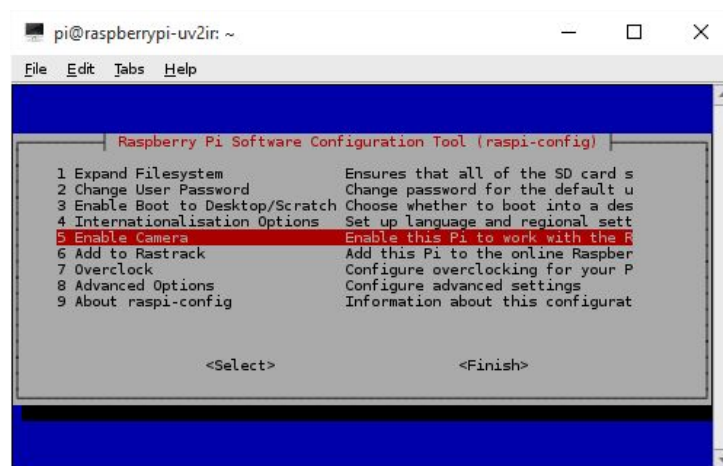
Remember Pythagoras

TESTING THE CAMERA

Hooking up the Camera

Follow these instructions:

https://www.raspberrypi.org/documentation/usage/camera/README.md

Make sure the camera is Activated

Type *sudo raspi-config* i n a terminal and make sure the camera is enabled. This should only have to be set once, and you will have to reboot after carrying out the initialization.

A Simple Camera Test

First change the directory to the Desktop:

cd Desktop

then type the following:

raspistill -o tst-cam.jpg

After a few seconds, a file named *tst-cam.jpg* will appear on the desktop. Right click on the file and click *Open* to display.

WORKING WITH PYTHON

Setting Up & Testing

- Open a terminal
- Type the following:

source ~/.profile
workon cv

You should see the prompt change with *(cv)* being placed at the beginning of the prompt.   This indicates that we are in the virtual python environment (it is possible to run multiple vesions for python in this way).
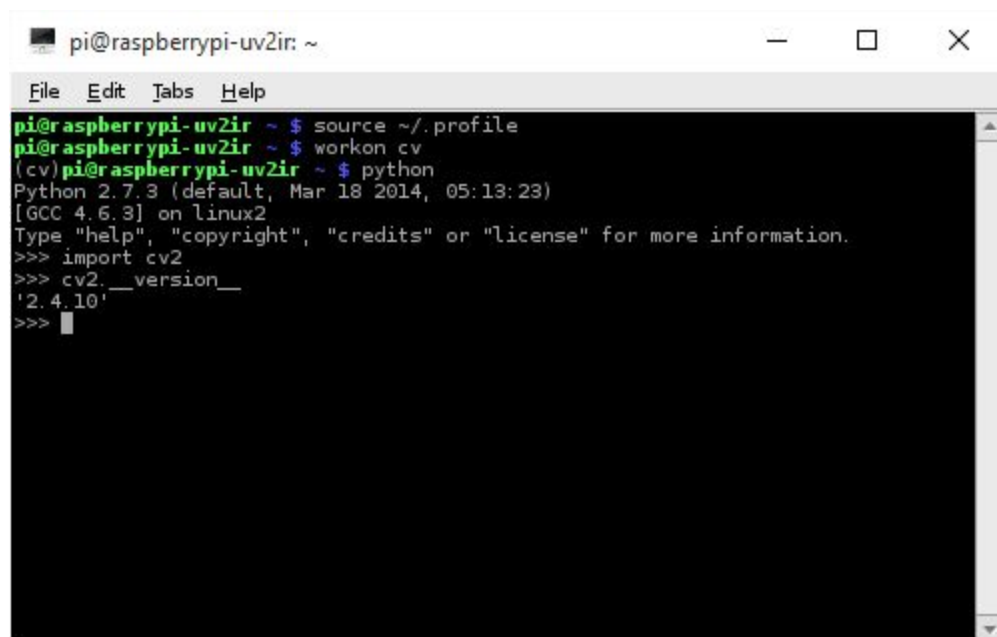
Type

python

to enter the python environment (prompt changes to **>>>**) and type the following two lines:

import cv2
cv2.__version__

The OpenCV version number should be returned.

Test the Camera with Python

open a terminal and type the following:

> ***source ~/.profile***
> ***workon cv***
> ***cd python-devl***
> ***python test-image.py***

Within a few seconds an image should appear on the screen.

The python program test-image.py is shown in the box below.

```
import the necessary packages
from picamera.array import PiRGBArray
from picamera import PiCamera
import time
import cv2

# initialize the camera and grab a reference to the raw camera capture
camera = PiCamera()
rawCapture = PiRGBArray(camera)

# allow the camera to warmup
time.sleep(0.1)

# grab an image from the camera
camera.capture(rawCapture, format="bgr")
image = rawCapture.array

# display the image on screen and wait for a keypress
cv2.imshow("Image", image)
cv2.waitKey(0)
```

APPENDIX A: RASPBERRY PI

A1: Creating a Raspberry Pi 2 Boot Disk from and img File

Carry out the following steps:

1. Place a blank micro-SD card in card reader (this shows up as *F:* in this Win 10 machine)
2. Run program *Win32DiskImager*
3. Select the appropriate image files (e.g. 20150902-RaspbianWheesy-openCV.img)
4. Click *Write* to create the bootable disk
5. Place the disk in the Raspberry Pi 2 and boot up
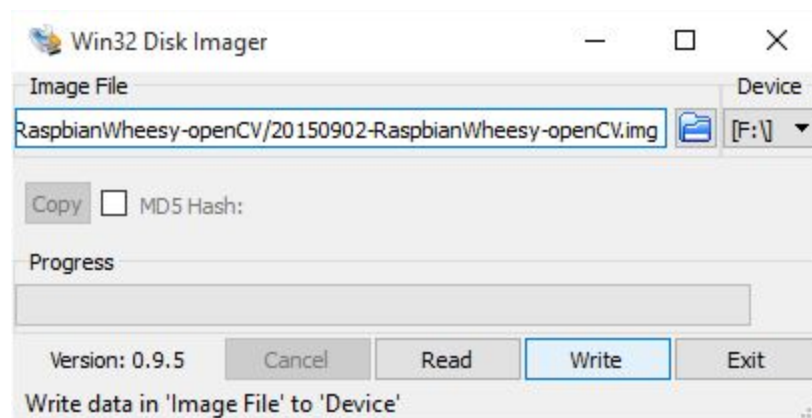
A2: Backing Up a Raspberry Pi 2 Boot Disk to an img File

Carry out the following steps:

1. Place micro-SD card in card reader (this shows up as *F:* in this Win 10 machine)
2. Run program *Win32DiskImager*
3. Choose a path and a name for the file (append .img to name)
4. Click *Read* to create the image file
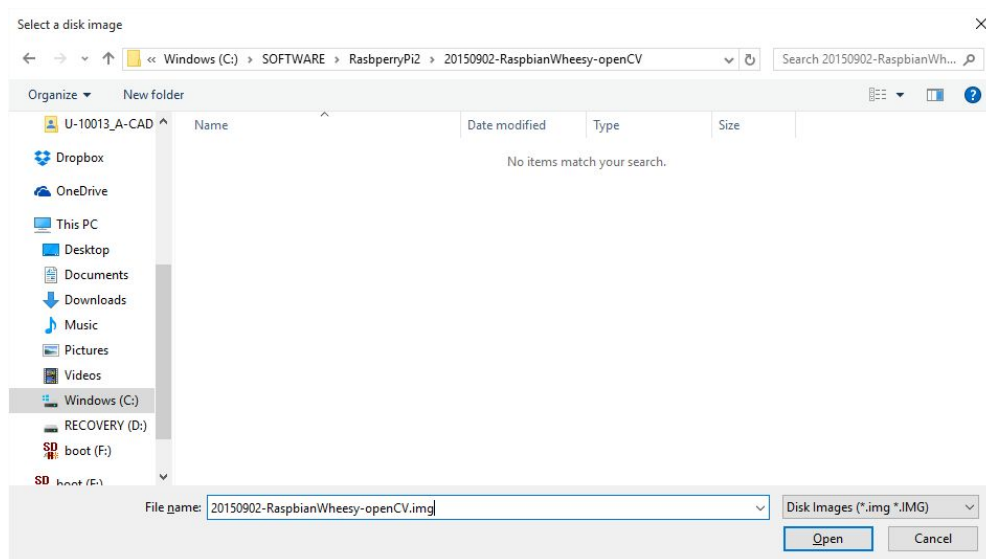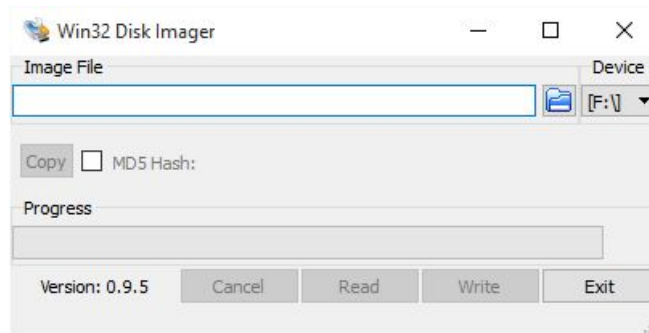
A3: Setting up a Static IP Address on RaPi2

A3.1 Temporary Change (until Reboot)

Open a terminal and type:

sudo ifconfig eth0 192.168.100.21

test that the change has taken place by typing ifconfig

This change will not survive a reboot.

A 3.2 Permanent IP Address Change (will survive reboot)

A static IP address should already have been set up on your RaPi2.   If for any reason you need to change it, or if it is set up for DHCP do the following:

Run LXTerminal and type the following:

sudo leafpad /etc/network/interfaces

Note that sudo designated that you are carrying out the action as the superuser (you may have to enter the password r2).

In the interfaces file look for a line such as:

iface eth0 inet dhcp

or

iface eth0 inet manual

Comment out this line (place # at beginning of line) and type the following

iface eth0 inet static
address 192.168.100.21
netmask 255.255.255.0

Save the file and reboot

Note that we recommend that you set your PC to a static address such as 192.168.100.20

A4: Accessing X11 Remotely from PC

The Raspberry Pi 2 is a UNIX backbone which out of the box can serve up X11 remote windows.

 Install the following programs on a Windows machine:

- putty - http://www.putty.org/
- Xming - http://sourceforge.net/projects/xming/

Run Xming

Clicking on 'Show Hidden Icons' on the desktop bar should show that the Xming server is running in the background, and running the cursor over the icon should show the message 'Xming Server:0,0'.
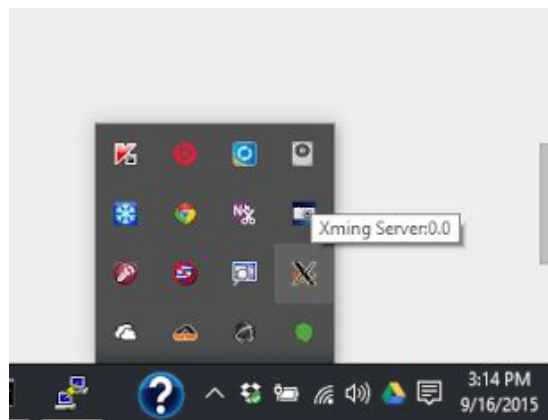
Run putty

- Put the static address of the RaPi2 into the "Host Name (or IP address) box
- Keep Port as 22 (unless you know otherwise)
- Enable X11 Forwarding under SSH/X11
- Save session for use at a later time
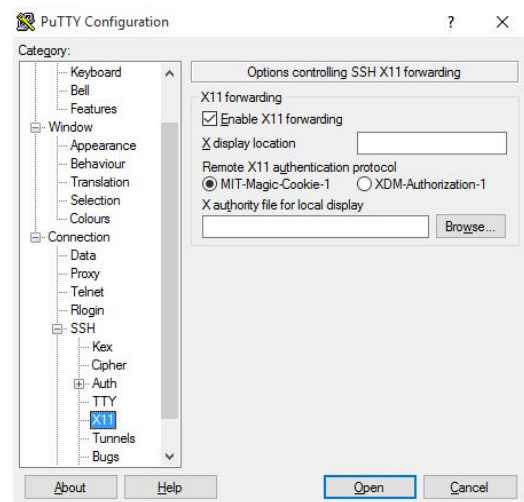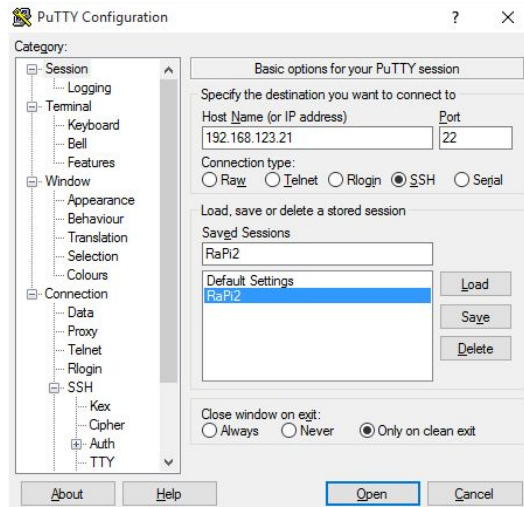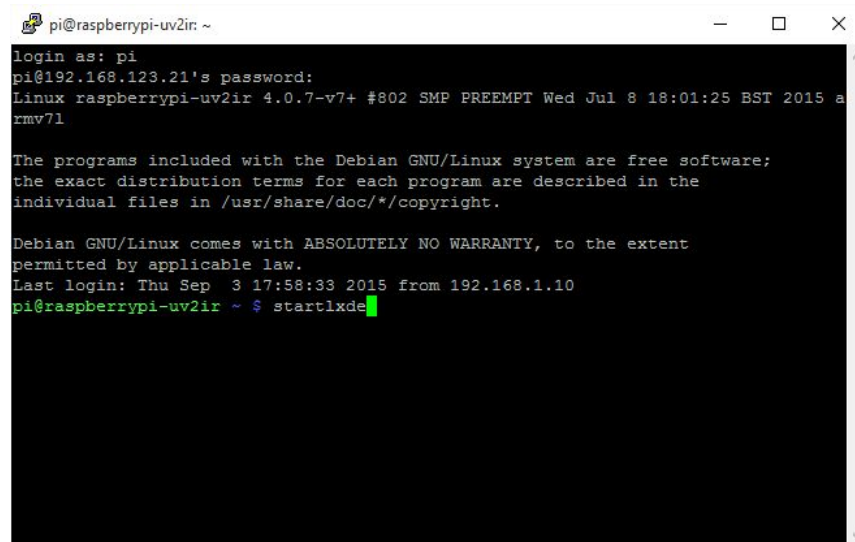
- Press 'Open' to open up a remote terminal on the RaPi2
- Enter your username and password (eg.: pi , r2)

A remote session will open.

- Type startlxde into the prompt and press Enter

The X11 windows session will open up.
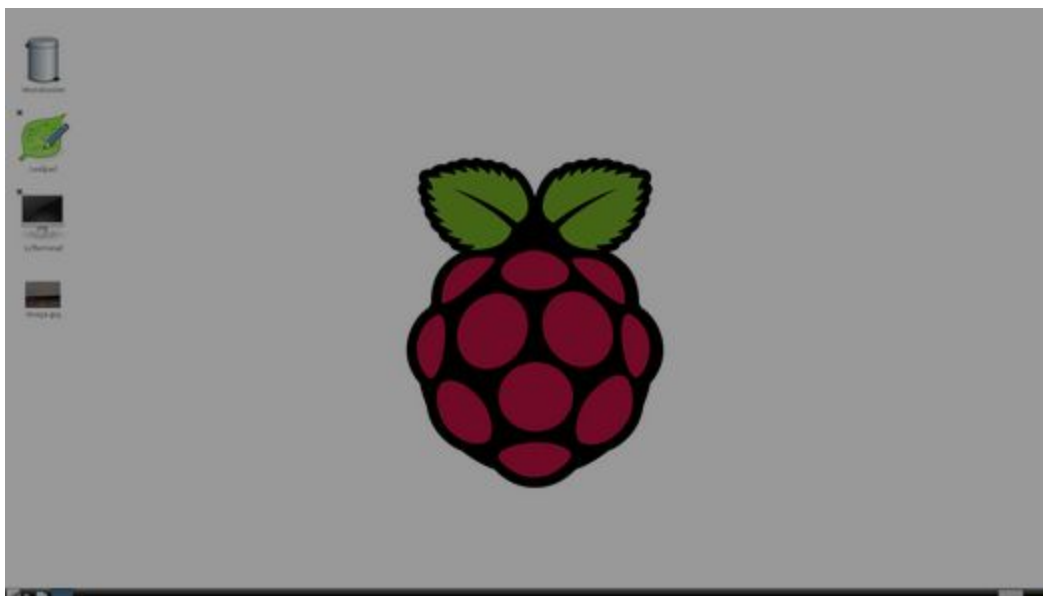
- To close the session, shut down the terminal window.

A5: Accessing X11 Remotely from an Apple Mac (OS X)

Since OS X is built on a UNIX backbone, getting the system to run on a mac computer is somewhat easier than for a Windows PC.

- Open a Terminal (Bash) from the Applications/Utilities menu
- Type the following:
    - ssh -X pi@192.168.100.21   (change username and IP address as appropriate)
- You will be prompted for the RaPi2 user password (corresponding to use pi)
- You are now logged into the RaPi2
- Type startlxde to see the remote desktop on the Apple machine

Note that XQuartz is not shipped in newer versions of OS X.   You will probably need to download and configure if you are using a Mac. Note also that XQuarx gets clobbered if you upgrade your OS X, so you may have to re-install after a OS X upgrade.

https://support.apple.com/en-us/HT201341

A6: Accessing X11 Remotely from an Linux (Ubuntu as Example)

- Open a Terminal
- Type the following:
    - ssh -X pi@192.168.100.21   (change username and IP address as appropriate)
- You should see the RaPi2 screen on your computer

- Run any program on the RaPi2 by typing in the command to run it (e.g. idle). The program will open up a window on your Linux machine.

A7: Virtual Network Adaptors

This allows one to set up a completely virtual network so that the host OS and the virtual OS can communicate with each other through the network adaptors.

http://coding4streetcred.com/blog/post/VirtualBox-Configuring-Static-IPs-for-VMs