Tutorial on Raspberry Pi with Camera

Internet of Things (2IMN15) 2016-2017, Eindhoven University of Technology
By Leila F. Rahman

This tutorial is about the configuration and tools of the Raspberry Pi boards that are equipped with a Camera module.

The Raspberry Pi board equipped with a Camera module has a 16 GB of micro SD card, installed with the following software which can be called from any location in the file system:

- Raspbian 4.9.2-10
- Maven version 3.2.5
- Java JDK 7 (including JRE)
- Python 3.4.3 (default Python, command: `python`)
- Python 2.7.9 (command: `python2` or `sudo python`)
- pip
- Yotta (build tool for mbed)
- GNU Make version 4.0
- cmake version 3.6.2
- gcc version 4.9.2
- clang version 3.5.0
- ccmake version 3.0.2
- vncserver

The Raspberry Pi has been set with enabled SSH and has the following credentials:

- User name: pi
- Password: tue321

There are two ways to access the Raspberry Pi:

1. Directly from the device by connecting the device to a monitor with an HDMI cable and to a keyboard
2. Through SSH from a PC/Laptop (if monitor or HDMI cable or keyboard not available)

In this tutorial, we will provide some guides for the following:

1. Installing necessary tools on PC
2. Using SSH from PC to access the Raspberry Pi
3. Testing the Camera Module
4. Available tutorials

1 NECESSARY TOOLS ON PC

1. Install TightVNC (http://www.tightvnc.com/download.php)
2. Install Sublime Text (https://www.sublimetext.com/) – optional
3. If using Windows, install Cygwin (with the necessary packages including git, wget, ssh, openssh, curl)
   https://cygwin.com/index.html
   http://www.davidbaumgold.com/tutorials/set-up-python-windows/
4. Install Nmap for Windows
   http://nmap.en.lo4d.com/download

2 SSH TO RASPBERRY PI

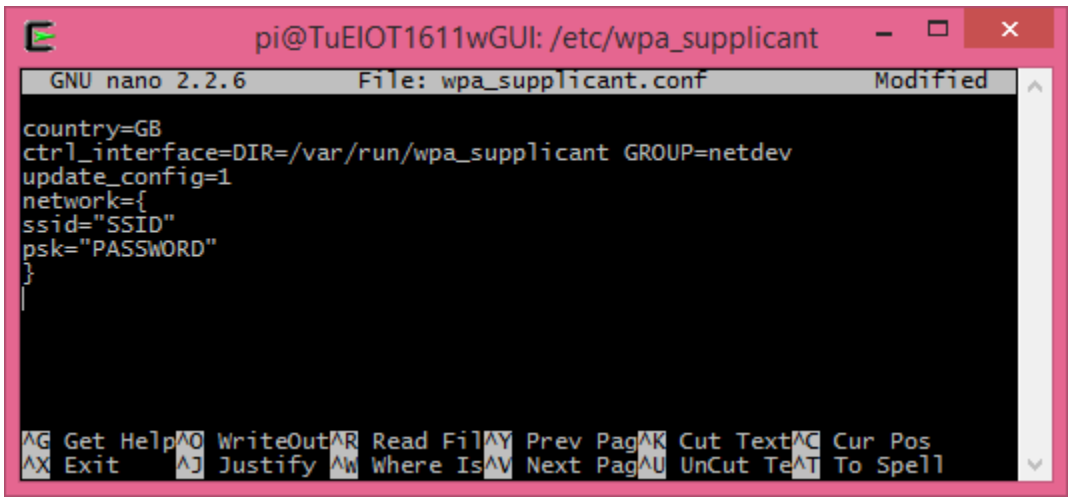
1. Connect Raspberry Pi to the local network using UTP cable
2. Run Nmap on PC, search for the Raspberry Pi's IP address by performing quick search on the IP domain of the local network (e.g. Target: 192.168.*.*, Profile: Quick Scan)
3. Using Cygwin, connect to the Raspberry Pi with SSH and the following command:
   a. *ssh pi@ip_address*
   b. Password: tue321
4. Change the password to a unique password during the assignment, however, change the password back to *"tue321"* when you return the Raspberry Pi at the end of the course. Use the "`passwd`" command to change the password.

5. Create a backup for the file `/etc/wpa_supplicant/wpa_supplicant.conf` with the following command:

   ```
   sudo cp wpa_supplicant.conf wpa_supplicant.conf.bak
   ```

6. Run the following command to see the SSID of your WiFi connection:
   `sudo iwlist wlan0 scan`

7. Set the WiFi SSID and PASSWORD and GROUP on */etc/wpa_supplicant/wpa_supplicant.conf* to be able to connect to the WiFi network
   a. `sudo nano wpa_supplicant.conf`
   b. replace the "SSID" and "PASSWORD" with the local WiFi credentials



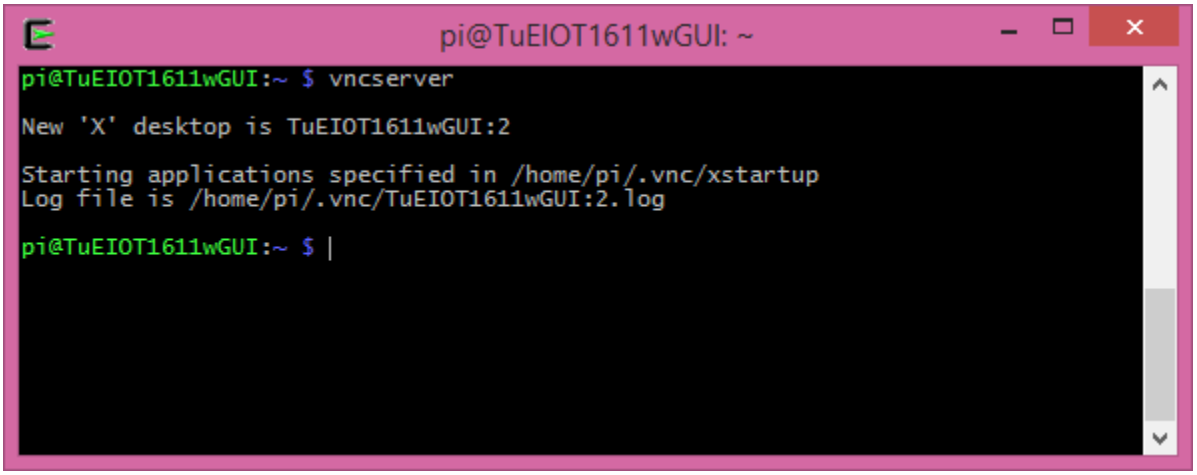
8. Save the file and restart the Raspberry Pi with the following command:

   `sudo shutdown -r now`

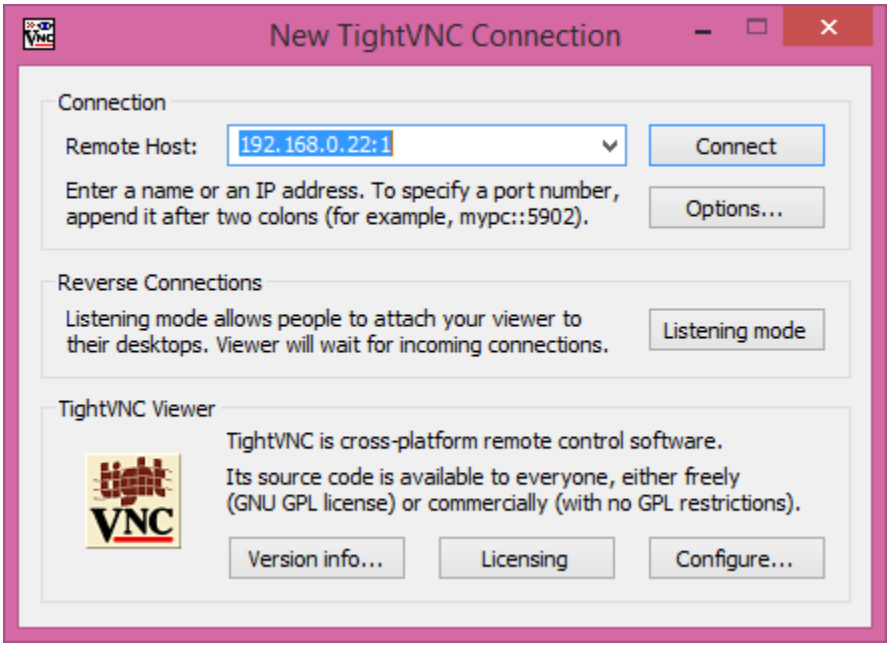
9. Raspberry Pi will be connected automatically to the local WiFi the next time it starts

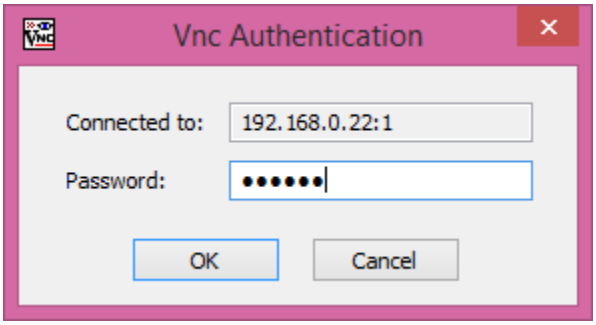
3 TEST THE CAMERA MODULE

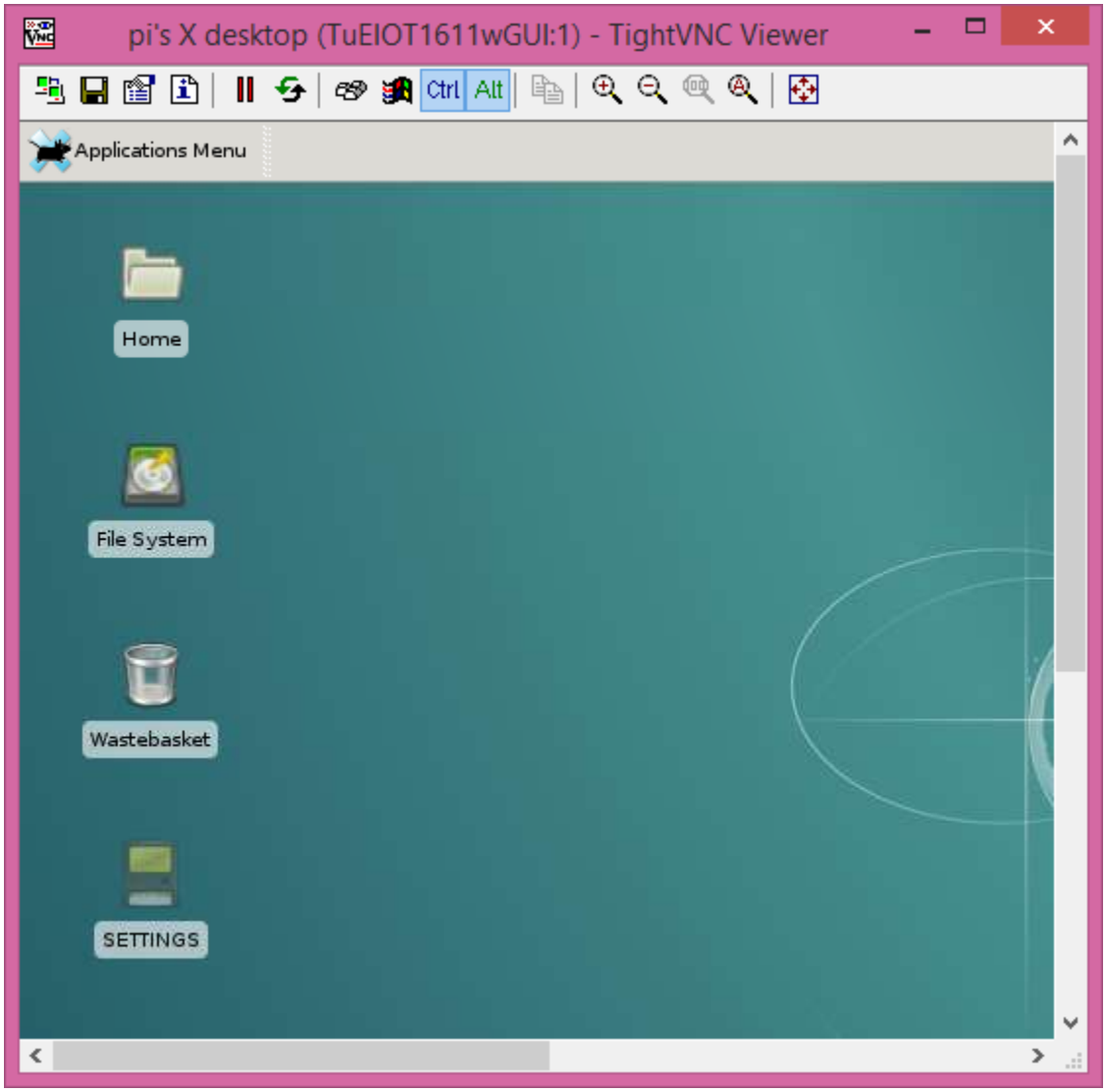
1. Remember to open the casing of the Raspberry Pi when running the camera module as the board may heat up.
2. Run `vncserver` on Raspberry Pi's command line interface (CLI) as shown below.



3. Run TightVNC and connect to the Rasperry Pi's server at port 1. Use the password "tue321". Look at screenshots below.


New TightVNC Connection
Connection
Remote Host:
192.168.0.22:1
Connect
Enter a name or an IP address. To specify a port number, append it after two colons (for example, mypc::5902).
Options...
Reverse Connections
Listening mode allows people to attach your viewer to their desktops. Viewer will wait for incoming connections.
Listening mode
TightVNC Viewer
TightVNC is cross-platform remote control software.
Its source code is available to everyone, either freely (GNU GPL license) or commercially (with no GPL restrictions).
Version info...
Licensing
Configure...

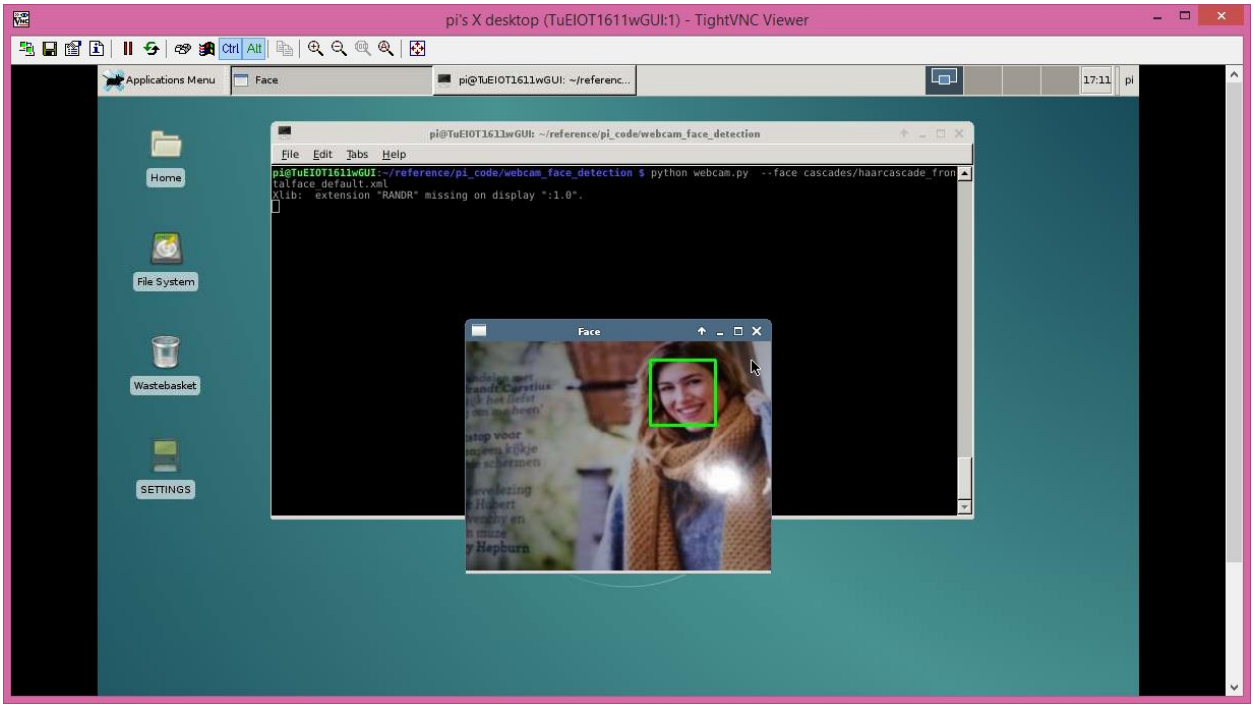

Vnc Authentication
Connected to:
192.168.0.22:1
Password:
OK
Cancel



4. The vnc connection should only be used for calibrating the camera position with respect to the face to be detected. For programming and other purposes, it is advised to use the command line interface. In the TightVNC window, right click your mouse and open a terminal. Run the code `webcam.py` at `~/reference/pi_code/webcam_face_detection` folder with the following command:

   ```
   python2 webcam.py --face cascades/haarcascade_frontalface_default.xml
   ```

   A new window will appear showing the camera stream, and a green rectangle will frame any detected face as shown in the following figure.



4 AVAILABLE TUTORIALS

Tutorials for the Internet of Things practical will be made available gradually at http://www.win.tue.nl/~lrahman/iot_2016/tutorial/ . List of provided tutorials include:

1. Tutorial for **Raspberry Pi with Sense Hat**
2. Tutorial for **Raspberry Pi with Camera module** (this document)
3. Tutorial for **txThings**, an open source implementation of CoAP in Python.
4. Tutorial on **mDNS-SD,** a service discovery protocol
5. Tutorial for **Eclipse Leshan**, an open source programming framework for developing LWM2M server and client in Java.
6. Tutorial for **Wakaama**, an open source programming framework for developing LWM2M server and client in C.
7. Tutorial for **mbed**, a semi open source programming framework for developing LWM2M server and client in C++
8. Tutorial for **Paho** and **Mosquitto**, open source implementation of MQTT client and server. Paho is available in several programming language.
9. **Protocol description** between the sensor/actuator and the broker, which will be based on the LWM2M and MQTT specification.