

Tutorial on Raspberry Pi with Sense Hat

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This tutorial is about the configuration and tools of the Raspberry Pi boards that are equipped with a Sense Hat shield. The Raspberry Pi boards that are equipped with a Camera module have different file system and configuration than the ones equipped with a Sense Hat shield, therefore, there is another tutorial for the Raspberry Pi boards equipped with Camera module.

The Raspberry Pi boards equipped with a Sense Hat shield have been configured and 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 2.7.9 and pip
- Raspberry Pi Sense Hat Python Module
- 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
- cmake version 3.0.2

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 Sense Hat shield
4. Available tutorials

1 NECESSARY TOOLS ON PC

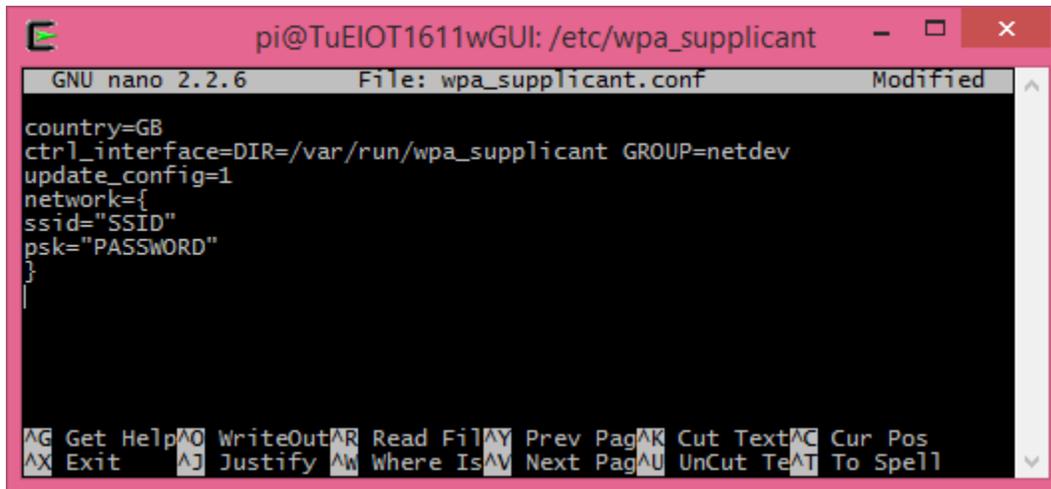
1. Install Sublime Text (<https://www.sublimetext.com/>) – optional
2. If using Windows, install Cygwin (with the necessary packages including git, wget, ssh, openssh, curl)
<https://cygwin.com/index.html>
<http://www.davidbaumgold.com/tutorials/set-up-python-windows/>
3. Install Nmap for Windows
<http://nmap.en.lo4d.com/download>

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

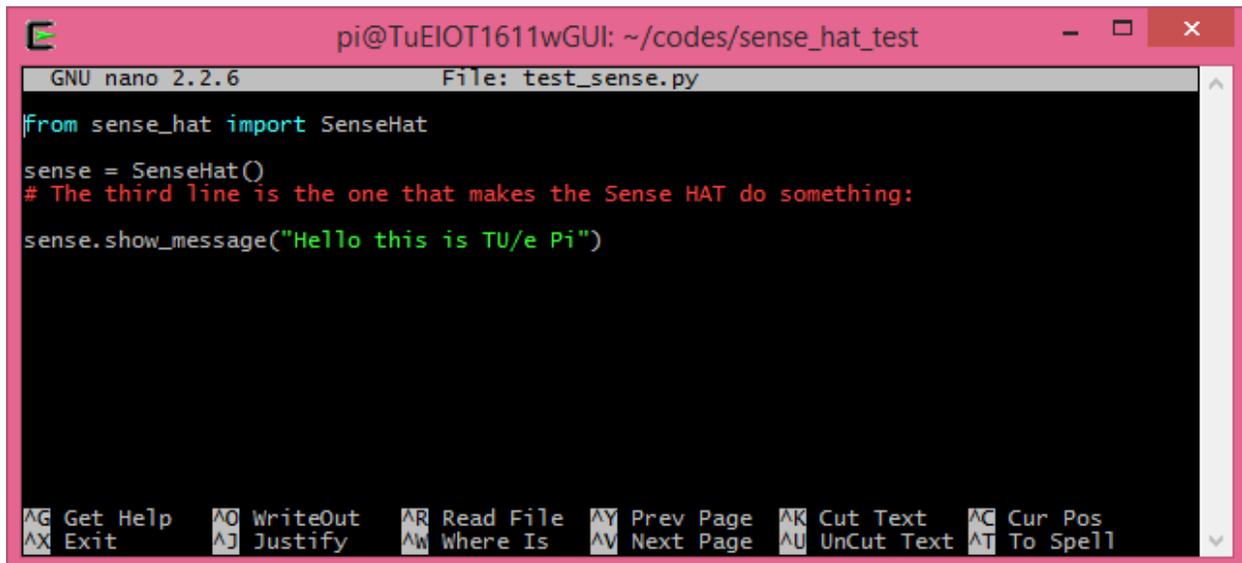


```
pi@TuEIOT1611wGUI: /etc/wpa_supplicant
GNU nano 2.2.6 File: wpa_supplicant.conf Modified
country=GB
ctrl_interface=DIR=/var/run/wpa_supplicant GROUP=netdev
update_config=1
network={
ssid="SSID"
psk="PASSWORD"
}
^G Get Help ^O WriteOut ^R Read File ^Y Prev Page ^K Cut Text ^C Cur Pos
^X Exit ^J Justify ^W Where Is ^V Next Page ^U UnCut Text ^T To Spell
```

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 SENSE HAT SHIELD

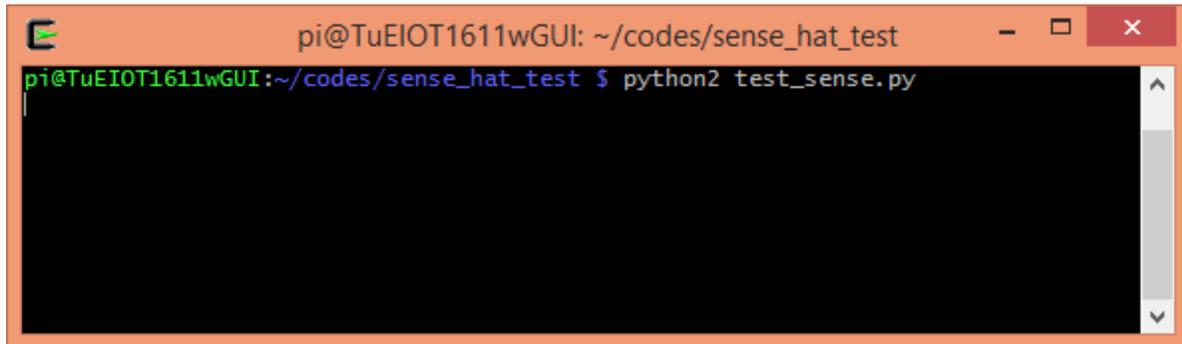
Create a `test_sense.py` file in directory `/codes/sense_hat_test` as shown in the following picture



```
pi@TuEIOT1611wGUI: ~/codes/sense_hat_test
GNU nano 2.2.6 File: test_sense.py
from sense_hat import SenseHat
sense = SenseHat()
# The third line is the one that makes the Sense HAT do something:
sense.show_message("Hello this is TU/e Pi")
^G Get Help ^O WriteOut ^R Read File ^Y Prev Page ^K Cut Text ^C Cur Pos
^X Exit ^J Justify ^W Where Is ^V Next Page ^U UnCut Text ^T To Spell
```

TUTORIAL ON RASPBERRY PI WITH SENSE HAT

Execute the file as shown below and you should have a running text on the LED matrix of the Sense Hat.

A terminal window with an orange title bar. The title bar text is "pi@TuEIOT1611wGUI: ~/codes/sense_hat_test". The terminal content shows a prompt "pi@TuEIOT1611wGUI:~/codes/sense_hat_test \$" followed by the command "python2 test_sense.py". The rest of the terminal area is black, indicating the script is running.

You can find more APIs for the Sense Hat in <http://pythonhosted.org/sense-hat/>

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** (this document)
2. Tutorial for **Raspberry Pi with Camera module**
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.