

RasPi-Fog : End User Tutorial

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1 Introduction

This tutorial or step-by-step guide shows you how to setup your own Fog-Computing Environment using Raspberry Pi's or similar edge node devices used for IoT applications. This specific tutorial is to setup a "Sleep Apnea Analyzer" which provides a user with Sleep Apnea disease severity and other parameters for in depth analysis.

Using Apache server and HTTP REST APIs you will be able to setup communication between Fog devices having a Master/Slave architecture. A "Master" is the Fog node that distributes work between the "Slave" or "Worker" nodes. A Master can itself also act as a Worker.

2 Material Required

For the Fog-Computing setup the following would be required:

1. 2 or more Raspberry Pi's : [Amazon Link](#)
2. HDMI cable : [Amazon Link](#)
3. Keyboard-Mouse : [Amazon Link](#)
4. Micro SD cards (Atleast 8 GB) : [Amazon Link](#)
5. Micro SD to SD adapter : [Amazon Link](#)
6. Monitor with HDMI input
7. USB Pendrive (Atleast 1 GB)
8. 5V - 2A power supplys with Micro USB output (Either of the two options)
 - Power Adapter : [Amazon Link](#)
 - Power Bank : [Amazon Link](#)
9. A PC with SD Card, USB slots and WiFi

3 Circuit

Connect the devices as per following steps:

1. Connect the Raspberry-Pi with keyboard and mouse.
2. Connect the Monitor to the Pi using HDMI Cable.
3. Power on the Monitor
4. Provide power to the Pi through adapter or power bank.

The final circuit is shown below.

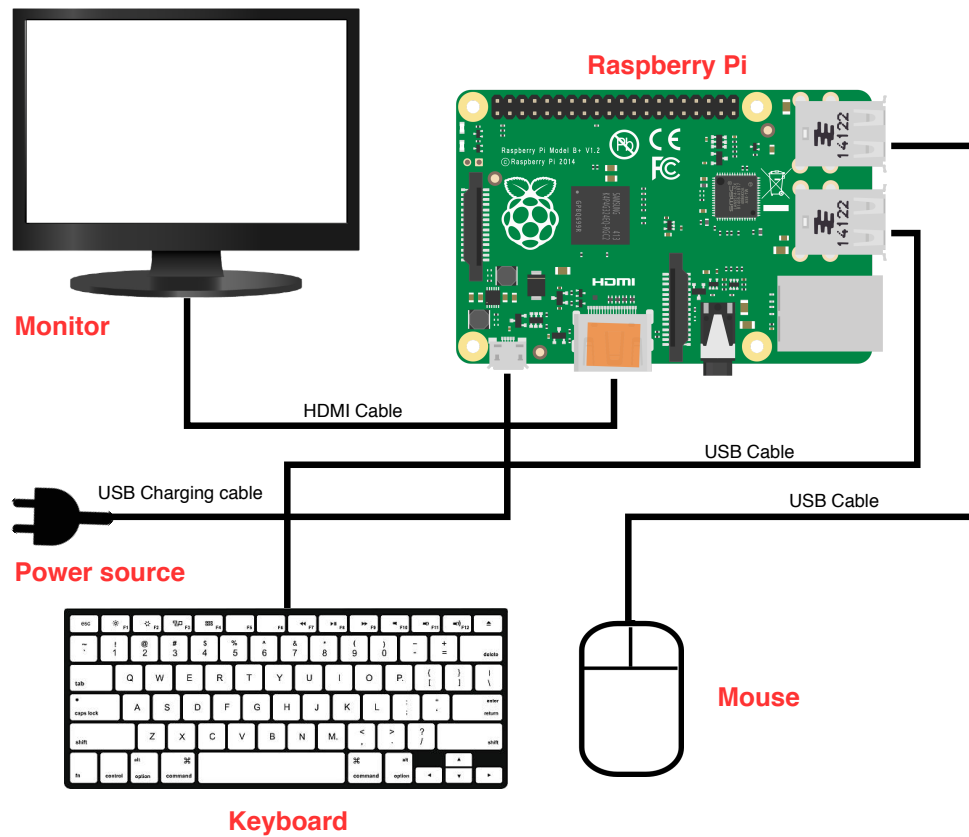


Figure 1: Circuit Diagram

4 Install OS

On PC follow the following steps:

1. Download the Raspberry Pi OS image : “Raspbian Stretch Desktop” from [this link](#)
2. Download and Install Disk Image flashing software like “Etcher” from [here](#).
3. Insert the Micro SD card inside the Micro SD to SD adapter and then insert the adapter to the SD Card slot in the PC
4. Run “Etcher” Software. Select the downloaded Raspbian image file, the SD Card drive and click on “Flash”.
5. When flashing and validation is over, eject the SD card adapter.
6. Repeat steps 3 to 5 for other Micro SD cards
7. Remove power cable from Raspberry Pi and insert the Micro SD Card. Re-insert the power cable into the Pi.

The Raspberry Pi would now boot up and is ready to install the required softwares for the Fog-Computing environment.

5 Installing Raspi-Fog : Worker

5.1 Raspberry Pi or other Linux machines

Open Terminal by pressing simultaneously : Ctrl-Alt-T and type in the following commands:

5.1.1 Install Java

```
1 sudo apt-get update
2 sudo apt-get upgrade
3 sudo apt-get install oracle-java8-jdk -y
4 sudo apt-get install ant git vim -y
```

5.1.2 Install Apache, PHP and MySQL

```
1 sudo apt-get install apache2 -y
2 sudo vim /etc/apache2/apache2.conf
```

Now on the bottom of the file type “i” to append document and add the following line:

```
1 ServerName 127.0.0.1
```

To test Apache run:

```
1 sudo apache2ctl configtest
```

The output of this command should be : “Syntax OK”. If yes, then Apache is installed and configured properly.

Now install PHP and MySQL using:

```
1 sudo apt-get install php libapache2-mod-php php-mcrypt php-mysql -y
2 sudo service apache2 restart
3 sudo apt-get install mysql-server -y
4 sudo mysql_secure_installation
```

When asked for password, enter “raspberrry”. For all other questions except the last question answer “n”, and for last “y”.

Now, configure MySQL and add database named “data” using:

```
1 sudo mysql -u root -p
2 CREATE DATABASE data;
3 show databases;
4 GRANT ALL PRIVILEGES ON data.* TO 'root'@'localhost' IDENTIFIED BY 'raspberrry';
5 FLUSH PRIVILEGES;
6 exit;
```

Install PHPMyAdmin using:

```
1 sudo apt-get install phpmyadmin -y
```

When prompted to choose server : select “Apache2”. In the Configure PHP-MyAdmin, select “No”.

Now add PHPMyAdmin configuration to Apache2 using:

```
1 sudo vim /etc/apache2/apache2.conf
```

In the end of file, select “i” to insert and add the following line:

```
1 Include /etc/phpmyadmin/apache.conf
```

Restart apache service using:

```
1 sudo service apache2 restart
```

Now, go to the html folder and add “HealthKeeper” scripts using following commands:

```
1 cd /var/www/html/
2 sudo mkdir HealthKeeper/
3 sudo chmod -R 777 HealthKeeper/
```

Download “HealthKeeper” data from this [link](#) and transfer files in the “Worker” folder to the, just created, HealthKeeper folder. in the `/var/www/html/` path. On terminal run the following commands to run the Analyzer:

```
1 cd /var/www/html/HealthKeeper
2 sudo chmod 777 *
3 javac ./analyzer.java
4 java analyzer
```

In another tab of terminal run:

```
1 hostname -I
```

It will show the IPv4 address of the machine. Note it for future use.


5.2 Windows Machines

Download XAMPP from the following [link](#) and Install XAMPP. Run XAMPP and start Apache and MySQL service.

Go to `C:/xampp/htdocs/` and create folder named “HealthKeeper”. Download “HealthKeeper” data from this [link](#) and transfer files in the “Worker” folder to the HealthKeeper folder.

Go to the folder `C:/xampp/htdocs/HealthKeeper/` and open terminal. Run the following commands to run analyzer:

```
1 javac ./analyzer.java
2 java analyzer
```


Press  + R, type “cmd” and then press “Enter”. On the command prompt type “ipconfig” and note the IPv4 address for future use.

6 Installing Raspi-Fog : Master

For Linux and Windows Machines follow the steps for Worker Installation, but instead of copying the Worker folder files, copy the Master and Worker folder inside `/HealthKeeper/RPi/` folder.

Go to the folder `C:/xampp/htdocs/HealthKeeper/RPi/Worker/` and open terminal. Run the following commands to run analyzer:

```
1 javac ./analyzer.java
2 java analyzer
```

Press  + R, type “cmd” and then press “Enter”. On the command prompt type “ipconfig” and note the IPv4 address for future use as the Master IP Address.

7 Configuring Raspi-Fog

On the master server, open browser and go to:

```
1 http://localhost/phpmyadmin/
```

Follow the following steps to configure database:

1. Create new database by clicking “New” in the left column. Enter name = “users” and click “create”.
2. Add a table in this database named “registrations” having 3 columns.
3. Type the column names as “ID”, “username” and “password”. Keep “ID” column as primary key and of type INT. Keep others as VARCHAR. Click on “Save” to create table.
4. On the top tab, click on “Insert” to insert an entry. Type in 1 in ID, and “admin” in username and password.
5. To add other users, follow step 4 with username and password as required.

7.1 Configuring Worker

Open browser and go to:

```
1 http://localhost/HealthKeeper/manager.php
```

Enter Master IP address as noted earlier. Once a worker node is configured, all connections other than power can be removed.

7.2 Configuring Master

Open browser and go to:

```
1 http://localhost/HealthKeeper/RPi/Master/manager.php
```

Add the IP addresses of the worker nodes noted earlier. Choose the “Enable Master as Worker” as per requirement.

Then go to:

```
1 http://localhost/HealthKeeper/RPi/Master/
```

Login with username : “admin” and password : “admin”. Enter data for analysis and press “Enter”. Then click “Analyze” to get results.

Android devices can also be synchronized with Master using the steps shown in next section, by which data need not be entered manually but by connecting the android device to a Bluetooth Oximeter.

8 Configuring Android Device

To configure an android device to send data collected through a Bluetooth Oximeter, download the android app from this [link](#). Install the app in android device and follow the following steps:

1. Turn on device's Bluetooth and then open the HealthKeeper app
2. You would be greeted by a welcome screen. Click on the “Pair Sensor” button and choose the oximeter device from the list.

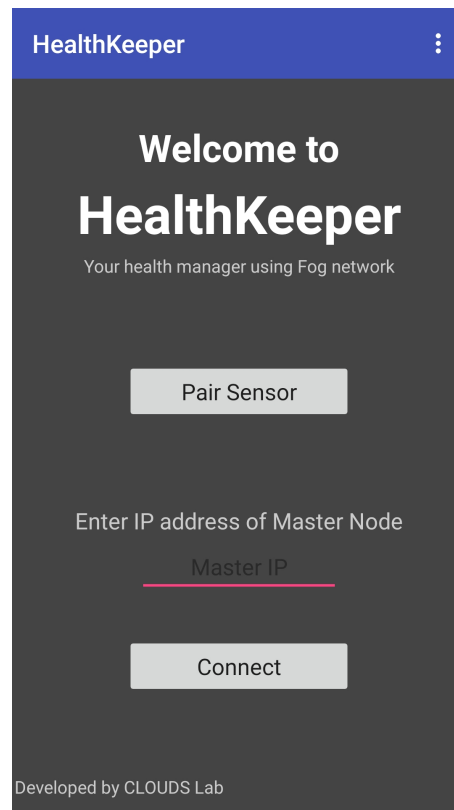


Figure 2: Welcome screen

3. Enter the IP address of the master node and click on “Connect”.

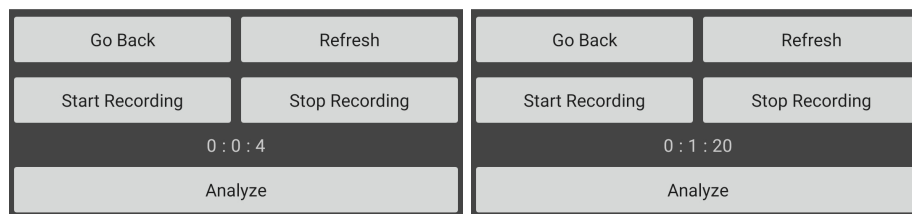
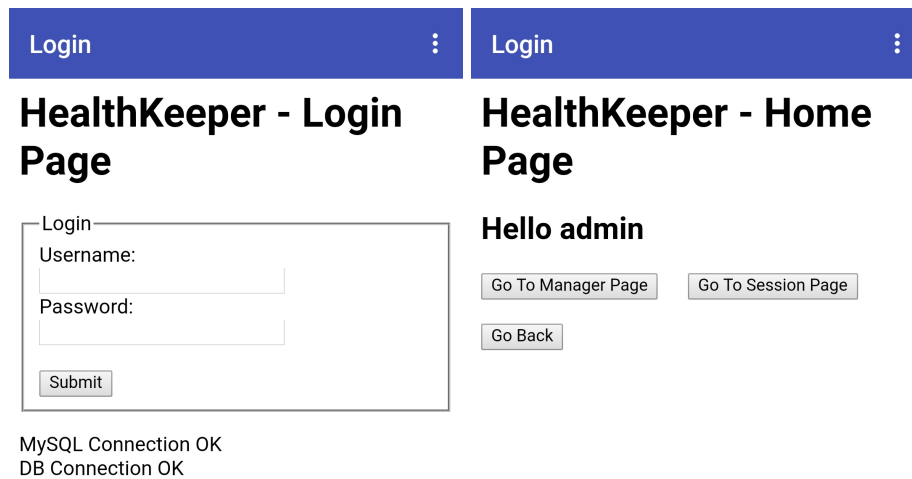


Figure 3: Login Page and Home Page

4. A login page would be visible, enter username and password and click on submit
5. On the Home Page, click on “Go To Manager Page” to setup worker nodes and enable/disable master as worker.

Login

Set Worker IPs here

Add Worker IP

☒ Enable Master as Worker

Add Worker

Remove all workers

Master IP address : 192.168.0.6

Go Back

Go Back

Refresh

Start Recording

Stop Recording

0 : 1 : 27

Analyze

Figure 4: Manager page

- Go back to Home Page and click on “Go to Session Page” to enter session.

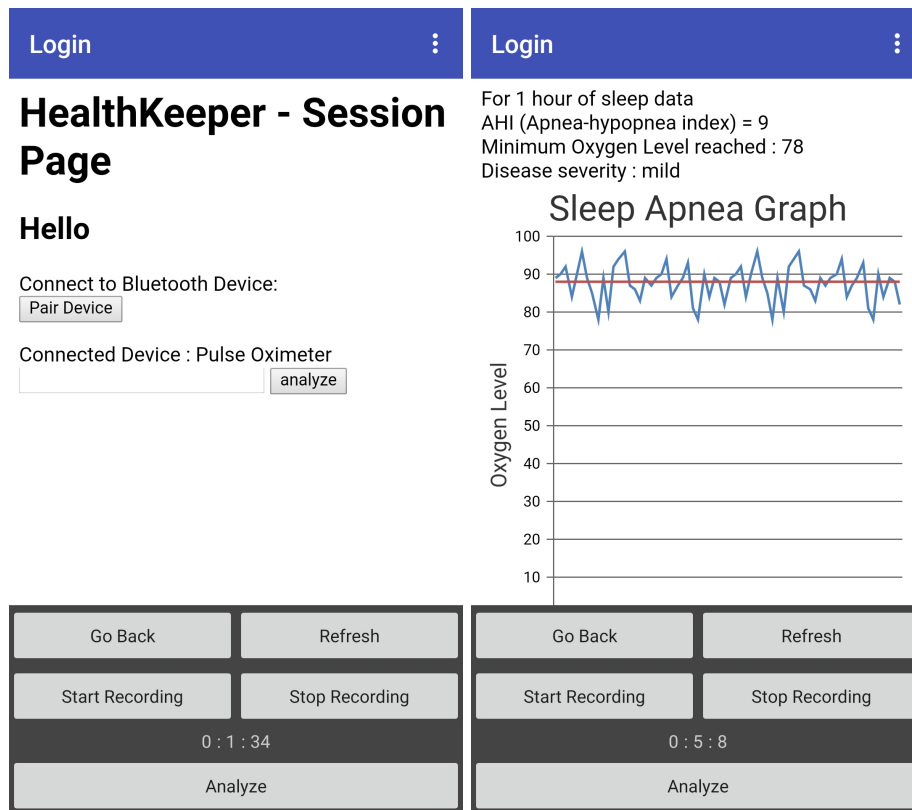


Figure 5: Session Page

7. Click “Start Recording” to start collecting data from Oximeter
8. Click “Stop Recording” to submit data to master node.
9. Click on “Analyze” button to submit data for analysis and view results on the current session.
10. Repeat steps 7 to 9 for analyzing more data.