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Raspberry pi  
Beehive monitoring

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Contents

[Purpose of this guide 2](#_Toc88074060)

[Who is this for? 2](#_Toc88074061)

[Hardware requirements 3](#_Toc88074062)

[Software requirements 3](#_Toc88074063)

[Installation instructions 4](#_Toc88074064)

[System update & software installation 4](#_Toc88074065)

[Remote Access & VNC configuration 5](#_Toc88074066)

[Camera configuration 5](#_Toc88074067)

[Enviro pHat configuration 6](#_Toc88074068)

[How to use the device 8](#_Toc88074069)

[Troubleshooting: 9](#_Toc88074070)

[Difficulties we encountered 9](#_Toc88074071)

[Next steps 10](#_Toc88074072)

[References 11](#_Toc88074073)

# Purpose of this guide

The aim of this step-by-step guide is to help the reader understand how to turn a Raspberry Pi into a simple beehive monitoring device with the following characteristics:

* Temperature, light level, pressure, and video monitoring.
* Remote access
* Low profile
* Easy to use
* Inexpensive

# Who is this for?

Beekeepers with an understanding of general computing terminology and basic Linux operation, looking for a convenient and inexpensive way of monitoring beehive conditions and activity.

# Hardware requirements

**This guide takes for granted that you already have:**

* Access to an internet connection via Ethernet ports
* Raspberry Pi 4 or newer
* Pi compatible keyboard, monitor, mouse, Ethernet cable, power supply
* SD Card with 8+ GB of storage
* Enviro pHat module with soldered headers attached to the Raspberry Pi
* Jumper / Ribbon cable
* External camera with USB 2.0 connector
* Remote client device with internet browsing capabilities

# Software requirements

You will require the following software:

**Raspberry Pi:**

* Raspbian Buster Desktop or newer
* Apache server
* MariaDB
* PHP
* Motion
* Enviro pHat module packages

**Client machine:**

* VNC Client
* Chrome or similar internet browser

# Installation instructions

System update & software installation  
From the terminal, install the following software:

**Raspbian update/upgrade:**

sudo apt-get update

sudo apt-get upgrade

**Apache Webserver & LAMP Stack:** (RaspberryPiFR, 2019)

sudo apt-get install apache2

**MariaDB:**

sudo apt-get install mariadb-server

(Depending on your system configuration, you may have to enter a password)

**PHP:**

sudo apt-get install php libapache2-mod-php

**Motion camera app:**

sudo apt install motion

**Enviro pHat module:**

sudo curl https://get.pimoroni.com/envirophat | bash

Once the required software is installed, we can configure the remote access.

## Remote Access & VNC configuration

To allow remote access to the Raspberry Pi, type the following command in the Raspberry Pi terminal:

sudo raspi-config

Note of the IP Address. It will be required when connecting remotely to the Raspberry Pi:

ifconfig

On the graphical desktop, navigate to **Menu > Preferences > Raspberry Pi Configuration > Interfaces >** and **enable SSH**

From the remote client's terminal, type:

ssh pi@ipaddress

Then enter the Raspberry Pi's password (default is "raspberry") to test the connection. (RaspberryPi, n.d.)

Connect using VNC Client and the Raspberry Pi's IP Address. It is highly recommended for both devices to be in the same network to simplify the installation process.

## Camera configuration

Open the configuration menu by clicking the raspberry **Menu** icon > **Preferences** > **Raspberry Pi Configuration**:

Then click on the **radio button** to enable the camera.

You can now test the camera from the terminal by typing the following command:

raspistill -o cam.jpg

It is highly recommended to use the official Raspberry Pi camera to simplify the installation. (RaspberryPi, n.d.)

## Enviro pHat configuration

Use the chmod command to give the server permission to access our script files by adding the following lines (Macdonald, n.d.)

cd /home/pi/Pimoroni/unicornhat/examples

chmod 777 \*

Now we will create this PHP script by typing nano:

<?php

exec('sudo /home/pi/Pimoroni/unicornphat/examples/simple.py');?>

Save the PHP code into a file called “simple.php” in the /var/www/html/ directory.

To allow our PHP web script to execute the python script as the super user, we must add this script to our sudoers file. Edit the file with this command:

sudo visudo

Then add this line at the bottom:

www-data ALL=NOPASSWD: /home/pi/Pimoroni/unicornhat/examples/\*

Downloading required files

We have uploaded the Python and PHP files that you can use to speed up the setup process. Just [click here to download the files](https://www.dropbox.com/sh/jc2ux74771ez8rw/AABB4NrH6seZMINg35rfUllja?dl=0).

They need to be installed in the following directories:

**temp.php:**

/var/www/html/

**temp.py:**

/home/pi/

**pressure.py:**

/home/pi/

**light.py:**

/home/pi/

Once the files are in place, you can continue to the next section.

# How to use the device

Placing the Raspberry Pi and the pHat at the right location is the key to obtain accurate readings:

Make sure that there is enough distance between the beehive and the device, and that the cables are secured and out of the way.

The Enviro pHat module should have its sensors aimed straight at the beehive to guarantee accurate readings.

Heat sources (including proximity to the power supply or direct sunlight over the pHat) other than the beehive, could distort the readings.

Once set up, all the interaction with the device is made via a web browser. In our case, we used Chrome.

To access remotely from the client’s internet browser, enter the following URL:

http://pi-ip-address/temp.php

Alternatively, you can access locally from the Pi’s web browser by typing:

http://localhost/temp.php

This will welcome you with a simple interface where the video feed, temperature, pressure, and light levels are displayed.

To read the values again, simply refresh your web browser.

# Troubleshooting

Q: **I'm not able to connect to the Raspberry Pi**

A: Double check that the connections details are correct and that the Ethernet cable (wired connections only) is connected properly. Double check the IP address.

Q: **I can't see video feedback from the device**

A: Double check that the camera is properly connected to the Raspberry Pi USB port and that MOTION is running

Q: **The temperature readings I'm getting are not accurate**

A: Ensure that the Enviro pHat is at least 2 inches (5 cm) away from the Raspberry Pi or other heat source but the one you are trying to measure. This is when the ribbon cable becomes most useful, as it allows for better placement of the module. (Macdonald, n.d.)

Q: **I’m not able to connect to the Pi using the VNC client.**

A: Try updating VNC server by typing the following command at the terminal:

sudo apt install realvnc-vnc-server realvnc-vnc-viewer

# 

# Difficulties we encountered

We were getting inaccurate readings when installing the Enviro pHat directly to the Raspberry Pi GPIO pins. This was solved by adding a ribbon cable that allowed us to distance the Enviro pHat from the Raspberry Pi .

Since we didn't have a cable with an insulation-displacement contact, we connected the Enviro pHat using a breadboard cable instead. This complicated the process as we now had to make sure each one of the cables was connected to the right GPIO pin. We searched online and used a tutorial on Raspberry Pi GPIO configuration. (RaspberryPi, GPIO, n.d.)

# 

# Next steps

This device would benefit from having power over Ethernet, as it would simplify the cabling inside the beehive.

We would like the device to constantly monitor the beehive without input from the user, and to incorporate notification functionality, to allow the device to send email alerts when temperature, pressure or light levels are not optimal.

A waterproof enclosure for the cables, Raspberry Pi, the camera and the pHat would lower maintenance costs and increase the device’s longevity.

# References

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