

Radiohound Project

Abbas Temos, Gonzalo Martinez, Nikolaus Kleber

Publication Date

09-12-2023

License

This work is made available under a Exclusive rights in copyrighted work license and should only be used in accordance with that license.

Citation for this work (American Psychological Association 7th edition)

Temos, A., Martinez, G., & Kleber, N. (2016). *Radiohound Project* (Version 1). University of Notre Dame. <https://doi.org/10.7274/24736260.v1>

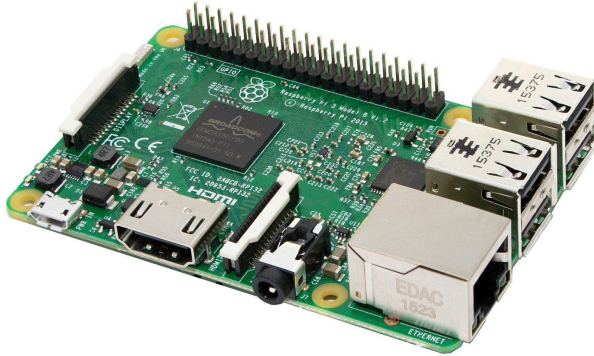
This work was downloaded from CurateND, the University of Notre Dame's institutional repository.

For more information about this work, to report or an issue, or to preserve and share your original work, please contact the CurateND team for assistance at curate@nd.edu.

Radiohound User Guide

What hardware do I need to use Radiohound?	2
How do I setup a sensor?	2
Requirements	2
Step by Step Guide	3
How do I interact with Radiohound?	6
Requirements	6
Installing Java	6
On Windows or Mac OS X	6
On Ubuntu Linux	6
Step by Step Guide to Interacting with Radiohound	7
Why do I see other sensors?	9
“I want to have my own Radiohound Cloud” Guide	9
Requirements	9
Cloud Setup - Step by Step Guide	9
Sensor Setup - Step by Step Guide	9
GUI Setup - Step by Step Guide	9
Source Code	10

What hardware do I need to use Radiohound?



Raspberry Pi 3



RTL-SDR

- A Raspberry Pi 3. You can grab the complete starter kit from [amazon](#) or if you already own an hdmi cable, a case, etc, you can also buy [only](#) the pi.
- An RTL-SDR [amazon](#)
- A Mac/PC to interact with Radiohound.

How do I setup a sensor?

Requirements

- Make sure you have all the hardware you need to run your Raspberry Pi properly. You can use The Raspberry Pi Foundation hardware guide: <https://www.raspberrypi.org/learning/hardware-guide/>
- Your Raspberry PI needs to have the latest version of Raspbian Operating System and be able to connect to the internet: Raspbian. The following Raspberry Pi Foundation [guide](#) will teach you how to install Raspbian, connect your Pi to the Internet (using wifi or cable) and will leave you ready to follow our Step By Step Guide.
- Plug in the RTL-SDR into one of the USB ports on the Raspberry Pi.

Step by Step Guide

1. Turn on your Raspberry Pi and login.
2. If you are using it in desktop mode, open a Terminal.
3. Run the following command `sudo apt-get update`.
4. Download our software using the following command (insert password if prompted):

```
wget https://curate.nd.edu/downloads/8623hx14166 --output-document  
radiohound_0.1-1_armhf.deb && sudo dpkg -i radiohound_0.1-1_armhf.deb
```

This will output a seemingly scary error message, but don't worry, it is expected to look like this:

```
Selecting previously unselected package radiohound.  
(Reading database ... 126384 files and directories currently installed.)  
Preparing to unpack radiohound_0.1-1_armhf.deb ...  
Unpacking radiohound (0.1-1) ...  
dpkg: dependency problems prevent configuration of radiohound:  
radiohound depends on libsodium13; however:  
Package libsodium13 is not installed.  
radiohound depends on libzmq3-dev; however:  
Package libzmq3-dev is not installed.  
radiohound depends on python-zmq; however:  
Package python-zmq is not installed.  
radiohound depends on xterm; however:  
Package xterm is not installed.  
radiohound depends on python-matplotlib; however:  
Package python-matplotlib is not installed.  
radiohound depends on python-scipy; however:  
Package python-scipy is not installed.  
radiohound depends on python-netifaces; however:  
Package python-netifaces is not installed.  
radiohound depends on cmake; however:  
Package cmake is not installed.  
radiohound depends on libusb-1.0-0-dev; however:  
Package libusb-1.0-0-dev is not installed.  
  
dpkg: error processing package radiohound (--install):  
dependency problems - leaving unconfigured  
Errors were encountered while processing:  
radiohound
```

5. Now run the following command:
`sudo apt-get install -f -y`
6. Your radiohound sensor should be ready to go. But before we test it, type and run "ifconfig". It will show information about your network configuration. The output should look like this:

```
pi@raspberrypi: ~  
File Edit Tabs Help  
pi@raspberrypi:~ $ ifconfig  
eth0      Link encap:Ethernet  HWaddr b8:27:eb:3a:84:fc  
          inet addr:129.74.158.207  Bcast:129.74.159.255  Mask:255.255.252.0  
          inet6 addr: fe80::e38e:770b:6bae:6ce4/64 Scope:Link  
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1  
          RX packets:2058 errors:0 dropped:130 overruns:0 frame:0  
          TX packets:150 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:1000  
          RX bytes:175257 (171.1 KiB)  TX bytes:21211 (20.7 KiB)  
  
lo        Link encap:Local Loopback  
          inet addr:127.0.0.1  Mask:255.0.0.0  
          inet6 addr: ::1/128 Scope:Host  
          UP LOOPBACK RUNNING  MTU:65536  Metric:1  
          RX packets:445 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:445 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:0  
          RX bytes:33538 (32.7 KiB)  TX bytes:33538 (32.7 KiB)  
  
wlan0     Link encap:Ethernet  HWaddr b8:27:eb:6f:d1:a9  
          inet6 addr: fe80::ba27:ebff:fe6f:d1a9/64 Scope:Link  
          UP BROADCAST MULTICAST  MTU:1500  Metric:1  
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:40 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:1000  
          RX bytes:0 (0.0 B)  TX bytes:8939 (8.7 KiB)
```

Write down the Hardware Addresses (the ones highlighted in yellow). One of these is going to be used to identify your sensor in the user interface.

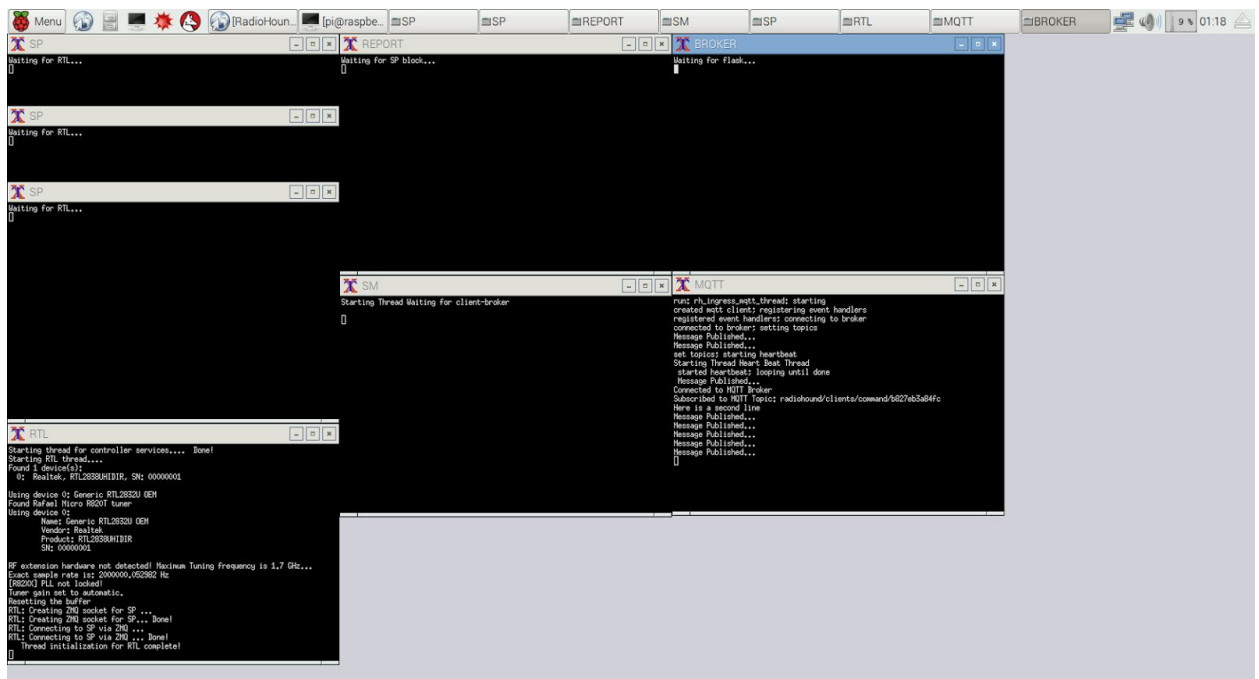
7. To test our installation run the following command if you are running it in desktop mode:

radiohound s

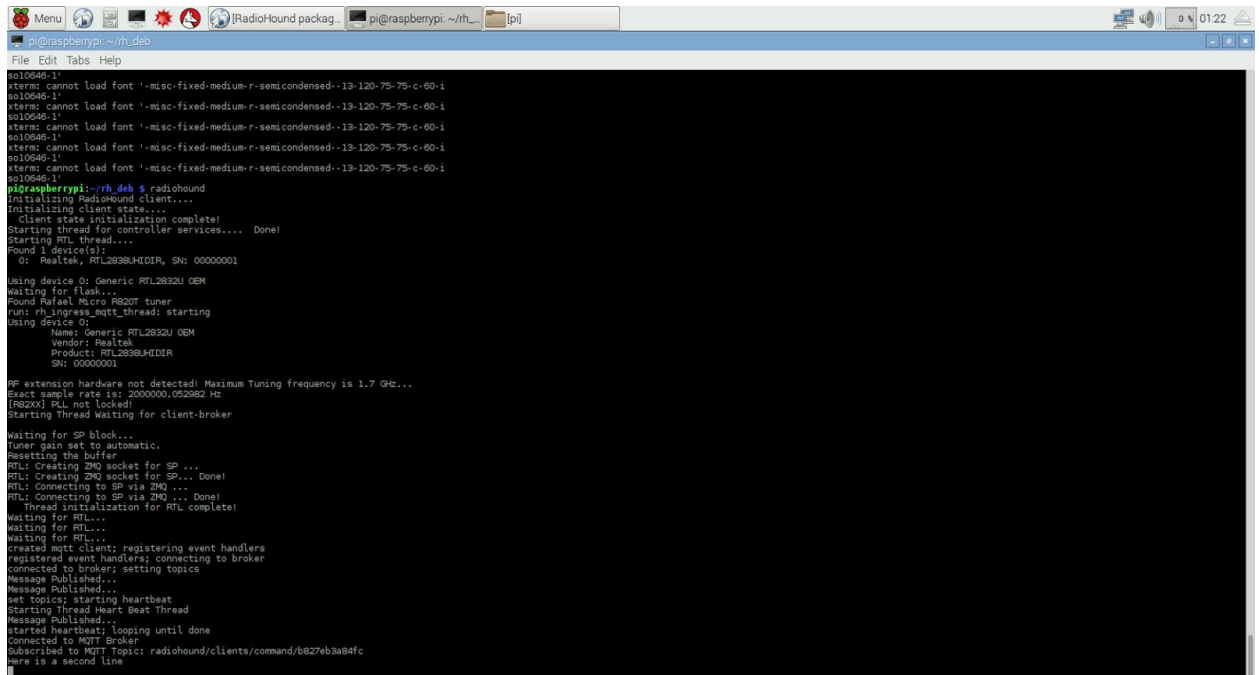
Or run the following command if you are running on console mode:

radiohound

Check that your output looks like one of the following pictures



Output of radiohounds (desktop mode)



Output of radiohounds (console mode)

8. Your Radiohound sensor is now ready. Reboot it by typing "reboot" in the terminal, and it will start the sensor software automatically.
9. You can now go to the next section.

How do I interact with Radiohound?

Requirements

- You need a PC/Mac with Windows, Mac OS or Ubuntu (or any other GNU/Linux distribution that supports Java).
- You need the latest version of Java (if you think you don't have the latest version of Java see "Installing Java" section).
- You need the latest version of Chrome, Firefox or Safari web browsers.

Installing Java

On Windows or Mac OS X

Installing Java in any of these operating systems works in the same way as installing any other program. Click [here](#) to download the latest version and run the installer once it is downloaded.

On Ubuntu Linux

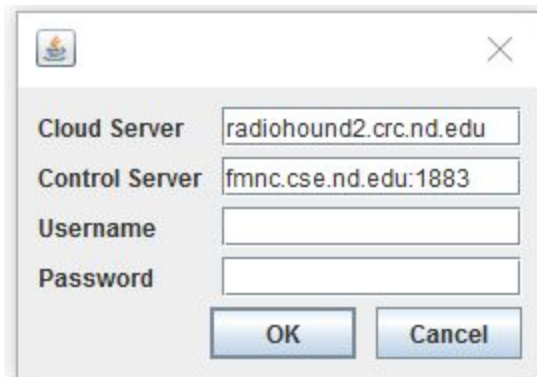
Installing Java in Ubuntu is a little bit trickier. Follow the following 5 step guide:

1. Open a Terminal
2. Type `sudo add-apt-repository ppa:webupd8team/java`
3. Type "Y" or "Yes" if prompted
4. Type `sudo apt-get update`
5. Type `sudo apt-get install oracle-java8-installer`


Step by Step Guide to Interacting with Radiohound

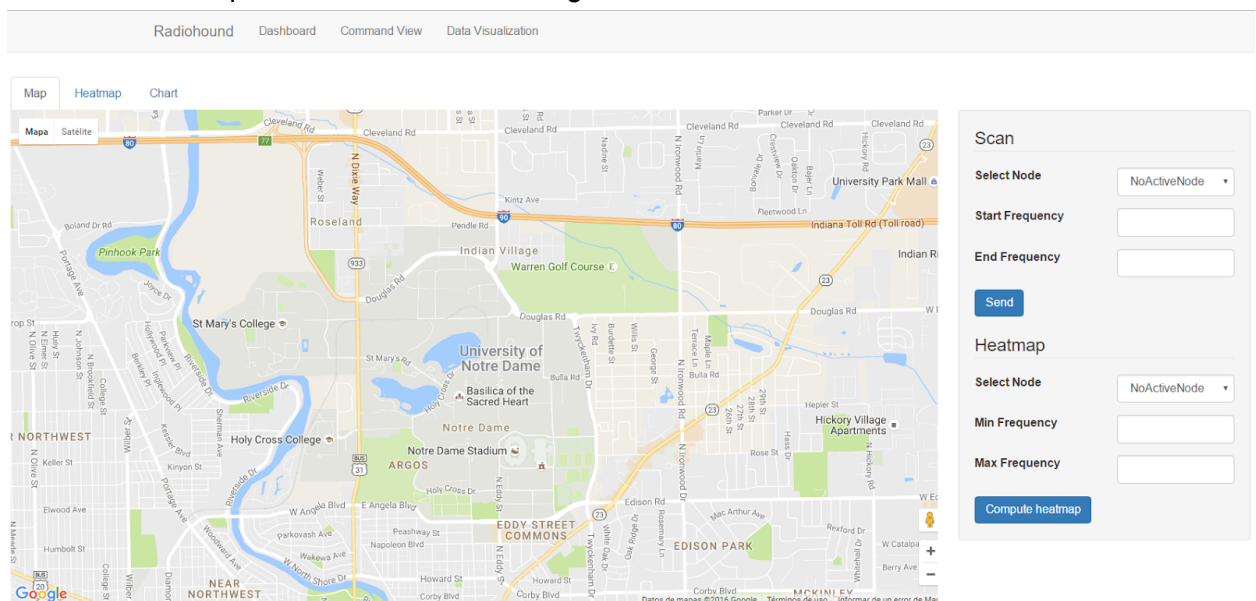
If you have read the requirements and your computer complies with them, then follow the next step by step process:

1. Download a jar file from here: <https://curate.nd.edu/downloads/8p58pc30f13>
2. After the download has finished, open the file.
3. You will see the following screen:

A Java-style login dialog box with a title bar containing a small icon and a close button. It has four text input fields: 'Cloud Server' (pre-filled with 'radiohound2.crc.nd.edu'), 'Control Server' (pre-filled with 'fmnc.cse.nd.edu:1883'), 'Username' (empty), and 'Password' (empty). At the bottom are 'OK' and 'Cancel' buttons.

Leave the Cloud Server and Control Server fields intact, and proceed to type “radiohound” in username and “radiohound12” in password. Then click OK.

4. It will take about 10 seconds (depending on the machine) to start the application, so please be patient.
5. When the application starts, the following icon  will appear on your taskbar and a web browser tab will open and show the following screen:

The screenshot shows the Radiohound web application. At the top is a navigation bar with links: 'Radiohound', 'Dashboard', 'Command View', and 'Data Visualization'. Below this is a map of a campus area (Notre Dame) with various landmarks labeled. On the right side, there are two control panels. The top panel, titled 'Scan', has a 'Select Node' dropdown (set to 'NoActiveNode'), 'Start Frequency' and 'End Frequency' input fields, a 'Send' button, and a 'Heatmap' section with 'Min Frequency' and 'Max Frequency' input fields and a 'Compute heatmap' button. The bottom panel, titled 'Map', has tabs for 'Map', 'Heatmap', and 'Chart'.

This is a preview of what is to come in the following releases of Radiohound. The only

active features that you can try by now are scanning the spectrum and visualizing the result in a periodogram. The following steps will guide you in how to do this.

6. If everything is working fine, you will see the MAC address of your node appear after a few seconds in the Scan panel on the right (in the Select Node drop-down menu). The MAC address will be one of the addresses that you wrote down in step 6 of the setting up the sensor guide.
7. After your node appears in the dropdown box, select it. Choose a start and end frequency which will determine the range of the spectrum that you will scan (the difference between end and start frequency needs to be ≥ 2 Mhz). For example, let's consider 90 to 100 Mhz. After selecting the start and end frequency click "Send".

Scan

Select Node

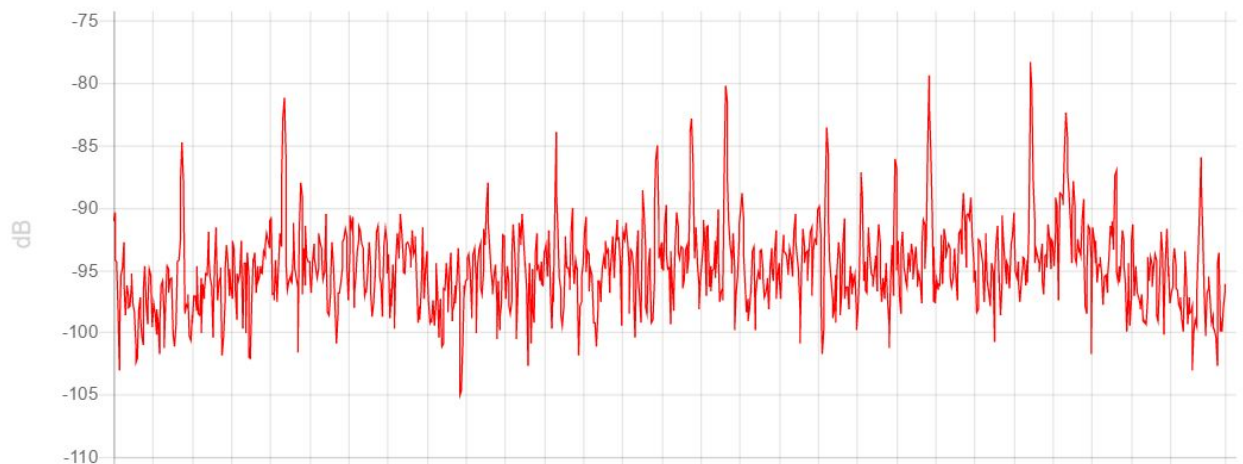
Start Frequency

End Frequency

8. On the navigation bar located at the top, click on "Data Visualization".



9. When your work is finished, in the dropdown box on the left, you will be able to select your node. Then in the dropdown box under that panel you will be able to choose one of the readings (your 10Mhz reading will appear as a series of 2Mhz readings from 90 to 100 Mhz) and a periodogram will be rendered. For example:



10. That is all the functionality that you can test now but we are working on bringing improvements as fast as we can, so stay tuned and keep downloading the latest release of Radiohound.

Why do I see other sensors?

It might happen that when you are selecting the Active Node, you see other Mac Addresses in the same dropdown box. The sensor configured in this guide is programmed to send the data back to the ND cloud, where you can see your own sensor and every other that is linked to our network. If you don't want to share the data that your sensor generates, then you have the option to setup your own cloud in the next section. Check the requirements before trying it out.

"I want to have my own Radiohound Cloud" Expert Guide

Requirements

In addition to the requirements listed in previous sections, you will need:

- To be comfortable using the console and running linux commands on your own.
- A computer to act as a server.
- To have docker installed and know how to run a docker machine, including publishing ports.

Cloud Setup - Step by Step Guide

1. Open your terminal in your computer
2. Pull the docker machine: heroiccoder/radiohound
3. Run it publishing ports 1883 (mqtt server) and 8000 (data warehouse server)
4. Wait for it to install
5. If everything went alright proceed to the next section.

Sensor Setup - Step by Step Guide

1. Install the debian package as per the user guide.
2. Edit file /usr/bin/common/definitions.py
3. Modify line 21: IP_ADDRESS = "fmnc.cse.nd.edu". Change to whatever the IP address / name is for your new server. Save it.
4. Edit file /usr/bin/common/definitions.py
5. Modify line 71: POST_LOCATION = '<http://radiohound1.crc.nd.edu/storedata/>' to the ip address/name of your new server. Leave "/storedata/" there. Save it.
6. Reboot

GUI Setup - Step by Step Guide

1. Download the jar and run it as per the user guide.
2. In the cloud server line, replace the current configuration with your own.
3. In the control server line, point to the same ip/name you used before.
4. Click on “OK” and run the app as usual.

Source Code

Radiohound is an open source solution. The source code that corresponds to the jar file is available here: <https://curate.nd.edu/downloads/8c97kp80k8z>

The source code of the rest of the solution will be published soon.