

User Guide

Radio Frequency Localisation of RFID Tags in a Raspberry-Pi Sensor Network

Aleksandar Krastev (s0833784)

s0833784@sms.ed.ac.uk

sandio.mama@gmail.com

August 20, 2013

1 Hardware

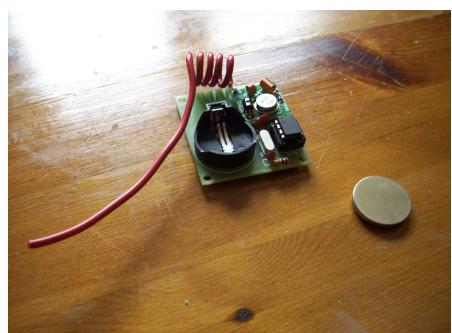
- **3 x Raspberry Pi computers** (Raspberry Pi Type B Single Board Computer 512MB)¹
- **3 x RFID readers** (RF9315R-u Active RFID 8 Meters Receiver with RSSI Module)²
- **1 x RFID tag** (RF8315T Active RFID 8 Meters Transmitting Module)³
- **3 x SD cards** (SanDisk 4GB SDHC Secure Digital Card)
- **3 x Power supplies** (UK 5V @ 1.2A power supply with integral 1.5m cable and micro-USB plug)



(a) Three Raspberry Pis



(b) Three active RFID readers



(c) One active RFID tag



(d) SD card



(e) Power supply

Figure 1: Hardware.

¹The Raspberry Pi website - <http://www.raspberrypi.org/faqs>.

²Ananiah Electronics active RFID reader - <http://www.ananiahelectronics.com/RF9315R-u.htm>.

³Ananiah Electronics active RFID tag - <http://www.ananiahelectronics.com/RF8315T.htm>.

2 Software

2.1 Operating System

The current operating system installed on the SD cards of the Raspberry Pis is Raspbian Linux⁴. Follow this guide if you want to install another Linux distribution: http://elinux.org/RPi_Easy_SD_Card_Setup. The devices have a user named **pi**. The password for both user **pi** and **root** is rfid2013michael.

2.2 Hostnames and IP addresses

The devices were renamed to **pi0**, **pi1**, and **pi2**. The Raspberry Pi computers, the SD cards, and the RFID readers were marked with numbers **0**, **1**, and **2**.

The devices have static IP addresses assigned for their wired network interfaces. The IP addresses that were chosen are **192.168.1.10**, **192.168.1.11**, and **192.168.1.12**. These can be changed in **/etc/network/interfaces** under root.

```
1 auto lo
2
3 iface lo inet loopback
4
5 auto eth0
6 iface eth0 inet static
7 address 192.168.1.12
8 netmask 255.255.255.0
9 broadcast 192.168.1.254
10 gateway 192.168.1.1
11
12 allow-hotplug wlan0
13 iface wlan0 inet manual
14 wpa-roam /etc/wpa_supplicant/wpa_supplicant.conf
15 iface default inet dhcp
```

Listing 1: The interfaces file of **pi2**

In addition, each computer can communicate with the others by name, which is defined in **/etc/hosts**.

```
1 127.0.0.1      localhost
2 ::1            localhost ip6-localhost ip6-loopback
3 fe00::0        ip6-localnet
4 ff00::0        ip6-mcastprefix
5 ff02::1        ip6-allnodes
6 ff02::2        ip6-allrouters
7
8 127.0.1.1      pi2
9 192.168.1.10    pi0
10 192.168.1.11   pi1
```

Listing 2: The hosts file of **pi2**

2.3 Web server

APACHE HTTP web server is running on **pi2** at **192.168.1.12**. It serves requests to display the web interface of the system. The website requires a password before it can be accessed. The username is michael and the password is rfid2013. All web files are located in **/var/www/**. The web interface is written in PHP.

2.4 Localisation System

First, make sure the RFID readers are connected to the Raspberry Pi computers. Also, ensure the computers are connected in a computer network. Then, the system starts by typing "python main.py" on the server Raspberry Pi computer **pi2**. Next, type "python network_client.py" on **pi0** and **pi1**. On the server **pi2** you will see the others connecting to it. If the RFID tag has its battery plugged in, then the computers will start receiving RFID measurements. The server will aggregate these values, update the database, and pass them to the localisation algorithm. The results will be visualised on the web interface.

⁴Raspbian Linux website - <http://www.raspbian.org/>

Specification	Value
Dimensions	8.6cm x 5.4cm
Weight	45g
Power source	5V MicroUSB or GPIO
Power rating	700mA (3.5W)
System on a chip	Broadcom BCM2835
CPU	700MHz ARM1176JZF-S
GPU	Broadcom VideoCore IV 250MHz
Memory	512MB
Storage:	SD card slot
USB 2.0 ports	2
Networking	10/100 Ethernet
Low-level peripherals	8 x GPIO, UART, I ² C bus, SPI bus
Operating system	Raspbian Linux
Price	US \$35

Table 1: Specifications of the Raspberry Pi Model B revision 2 single-board computer.

Specification	Value
Dimensions	4cm x 6cm x 1.8cm
Operating Temperature	0 - 50° C
Operating Frequency	315 MHz
Incoming signal range	60 dBm
Power source	Serial / USB port, DC 9V socket
Communication	RS-232 serial port
Watchdog timer	2.3 seconds
Simultaneous reads	80 tags
Reader control	No control protocol
Data representation	Raw character data, No data encryption
Data output	ID: 4 characters + RSSI: 0-255
Price	US \$49.95

Table 2: Specifications of RF9315R-u active RFID reader.

Parameter	Value
Baud rate	9600 bits per second
Data bits	8 bits
Stop bits	1 bit
Parity	None
Flow control	None

Table 3: Serial port parameter settings to communicate with the readers.

Specification	Value
Dimensions	4cm x 5cm x 1.8cm
Operating Temperature	0 - 50° C
Operating Frequency	315 MHz
Power source	CR2025 / CR2032 battery
Battery life	5,000 / 7,000 hours
Power consumption	4mA when transmitting, 19uA when idle
RF output power	< 2mW
Effective range	8 meters with 8mm coil diameter, 2cm long antenna
Data output	ID: 4 characters
Price	US \$19.95

Table 4: Specifications of RF8315T active RFID tag.