Raspberry Pi School Radio Player

Overview: We are going to do something a bit different with this resource pack. Most of the School Radio resources focus on using your School Radio system to accomplish a number of radio related tasks that will help you to meet key requirements of the National Curriculum as well as help your students to get the most from their radio station.

In this tutorial we will be looking at how students can build their own School Radio Player hardware using a Raspberry Pi. This project relates directly to several areas of the Computing section of the National Curriculum.

Key skills used include:

- Introduction to how the Internet is used to deliver School Radio to listeners via tablets, PC's, laptops and phones.
- See how even a very simple digital device (such as a Raspberry Pi) can be used to gain access to School Radio.
- Learn how to setup a basic Raspberry Pi installation from scratch.
- Update the new Linux installation and install & configure the additional software needed to convert the Pi in to a School Radio player.
- Discuss how the project could be advanced with the addition of a user interface, wireless compatibility or even hardware I/O (buttons to turn the volume up and down!).

Computing – Years 1-6

General Aims

The national curriculum for computing aims to ensure that all pupils:

- Can understand and apply the fundamental principles and concepts of computer science, including abstraction, logic, algorithms and data representation. (page 204)
- Can evaluate and apply information technology, including new or unfamiliar technologies, analytically to solve problems. (page 204)

Attainment Targets

By the end of each key stage, pupils are expected to know, apply and understand the matters, skills and processes specified in the relevant programme of study.

Key Stage 1

- Use technology purposefully to create, organise, store, manipulate and retrieve digital content. (page 205)
- Recognise common uses of information technology beyond school. (page 205)

Key Stage 2

- Understand computer networks including the internet; how they can provide multiple services, such as the world wide web; and the opportunities they offer for communication and collaboration. (page 205)

Key Stage 3

- Understand the hardware and software components that make up computer systems, and how they communicate with one another and with other systems. (page 206)
- Undertake creative projects that involve selecting, using, and combining multiple applications, preferably across a range of devices, to achieve challenging goals, including collecting and analysing data and meeting the needs of known users. (page 206)
- Create, re-use, revise and re-purpose digital artefacts for a given audience. (page 206)

Key Stage 4

- Develop their capability, creativity and knowledge in computer science, digital media and information technology. (page 207)

Let's Build A School Radio Player!

Building a School Radio Player using a Raspberry Pi might sound like a daunting task but thanks to the stellar work of the Raspberry Pi Foundation and the thousands of enthusiasts around the world, the tools and information you will need are readily available and in fact, your students will have working School Radio Players by the end of a single lesson. But first must check we have the equipment that we will need.

Equipment List:

- Raspberry Pi Model B*
- Raspberry Pi Power Supply
- Raspberry Pi Case (not 100% needed)
- Blank SD Memory Card (4GB minimum)
- Standard USB Keyboard & Mouse
- HDMI Compatible TV or PC Monitor
- Network Connection (cable) With Internet Access.
- Access To A PC (or Mac) With An SD Card Reader
- Pair Of Speakers Or Headphone For Testing

*It is important that you have the Model B as the Model A had a notoriously unreliable sound chipset and no network connection built in. The Model B+ should be fine although we have not tested it.
Once we are sure we have everything we need, it is time to get started. The process we will use is as follows:

1. Install a brand new instance of Raspbian on our SD card.
2. Setup Raspbian and select the default sound output for our player.
3. Update all the software to the latest versions.
4. Install a special program called a music player daemon which will connect to the School Radio service.
5. Configure the Pi connect to your School Radio stream and play on boot.

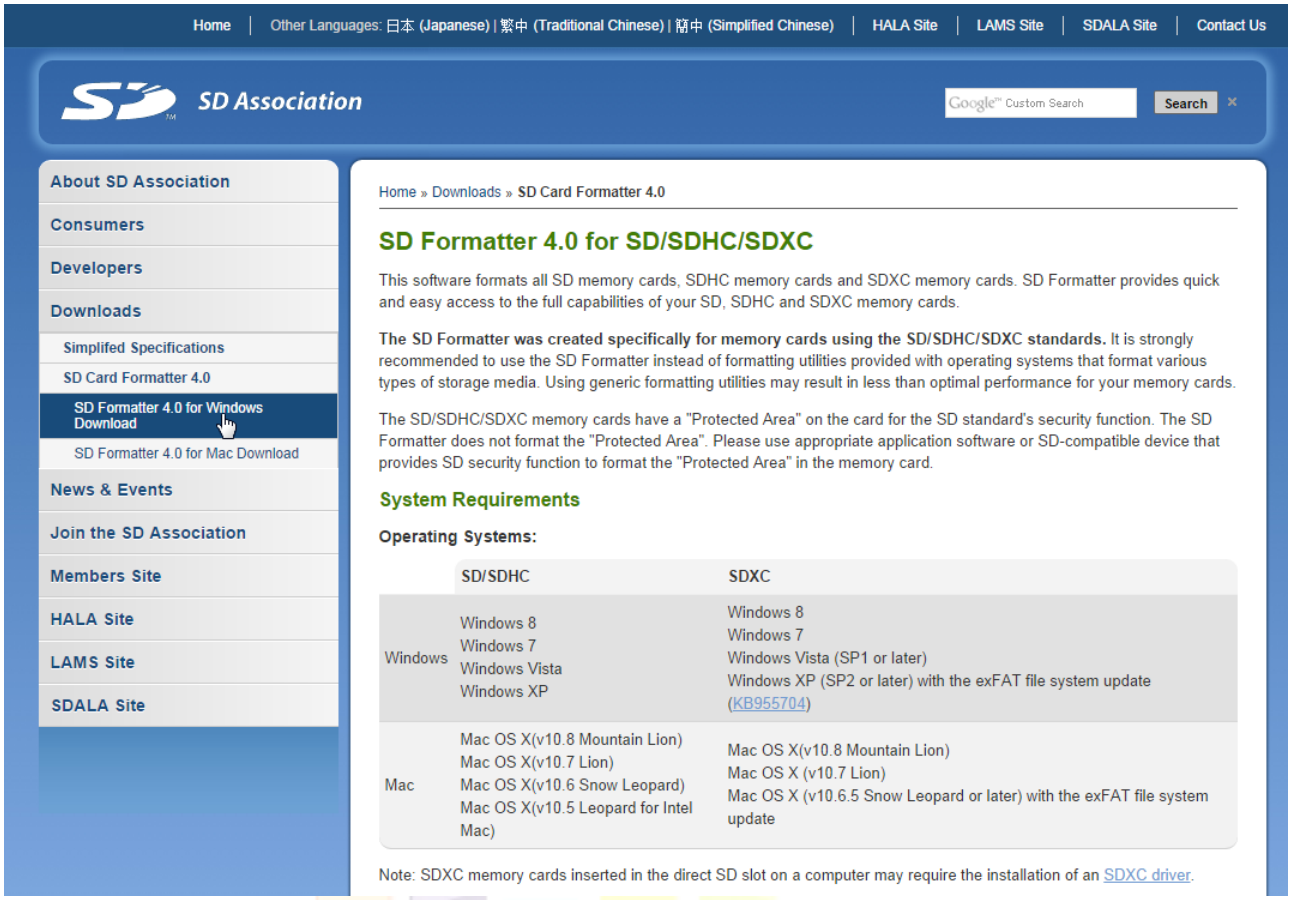
And these five steps are all you need to build your School Radio Player. So let's get started.

Step 1 - Install A New Copy Of Raspbian On Your Pi.

To install the Raspbian Linux OS onto your PI you will need an SD Memory card with at least 4GB of space. It is best to use the latest version of Raspbian so we would recommend formatting your SD card and then downloading the latest NOOBS image from www.raspberrypi.org/noobs-setup

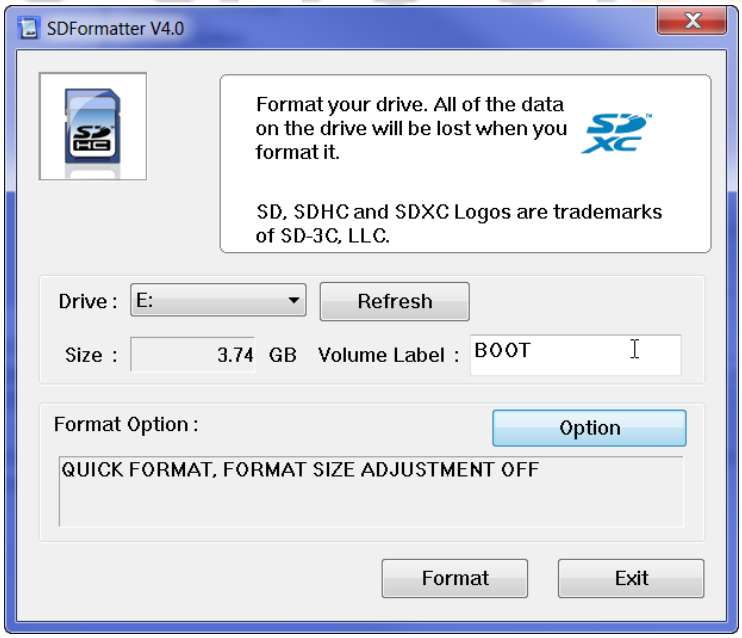
First we want to format our SD card. To do this visit https://www.sdcard.org/downloads/formatter_4 and click on the download link for SD Card Formatter 4.0. In this example we are using a Windows PC to format the SD card and copy on the NOOBS image so we will select the Windows version of the formatting tool.

You will be asked to accept the license agreement and then the download should automatically start.



Once the download is complete, locate the SDFormatterv4.zip file (probably in your downloads folder unless you specified another location), double click on it and then run the Setup.exe file.

This will run through a simple installation wizard, just follow the onscreen prompts to complete the installation. Once it is installed, make sure your SD card is inserted into your PC and then run the SD Formatter 4 application.



To format the SD card, just click on the Format button and follow any onscreen prompts.

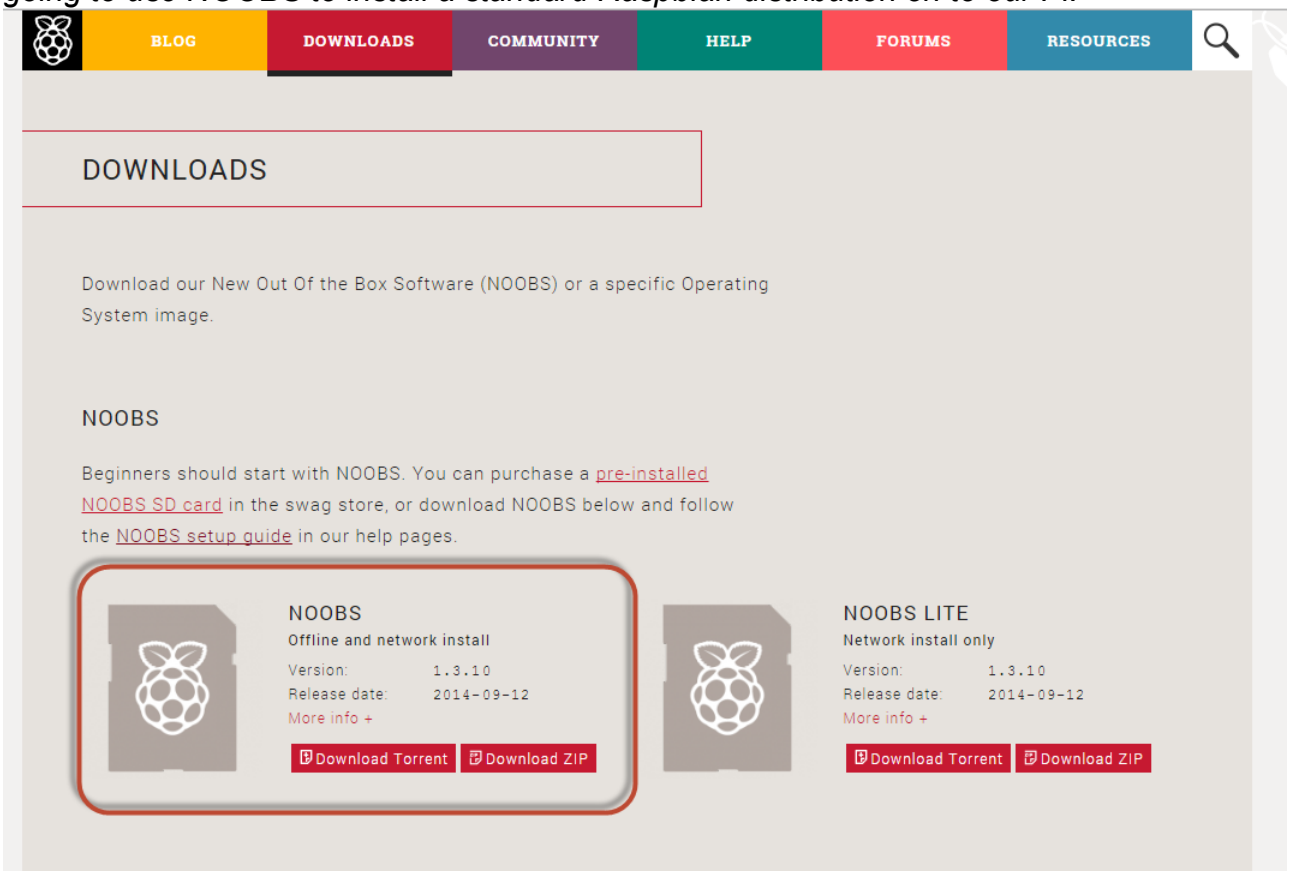
Next you need to head over to the Raspberry Pi Foundation's website to download the NOOBS packages.

Visit: http://www.raspberrypi.org/downloads/

Click on the Download ZIP button to download the NOOBS package.

TIP: What is NOOBS?

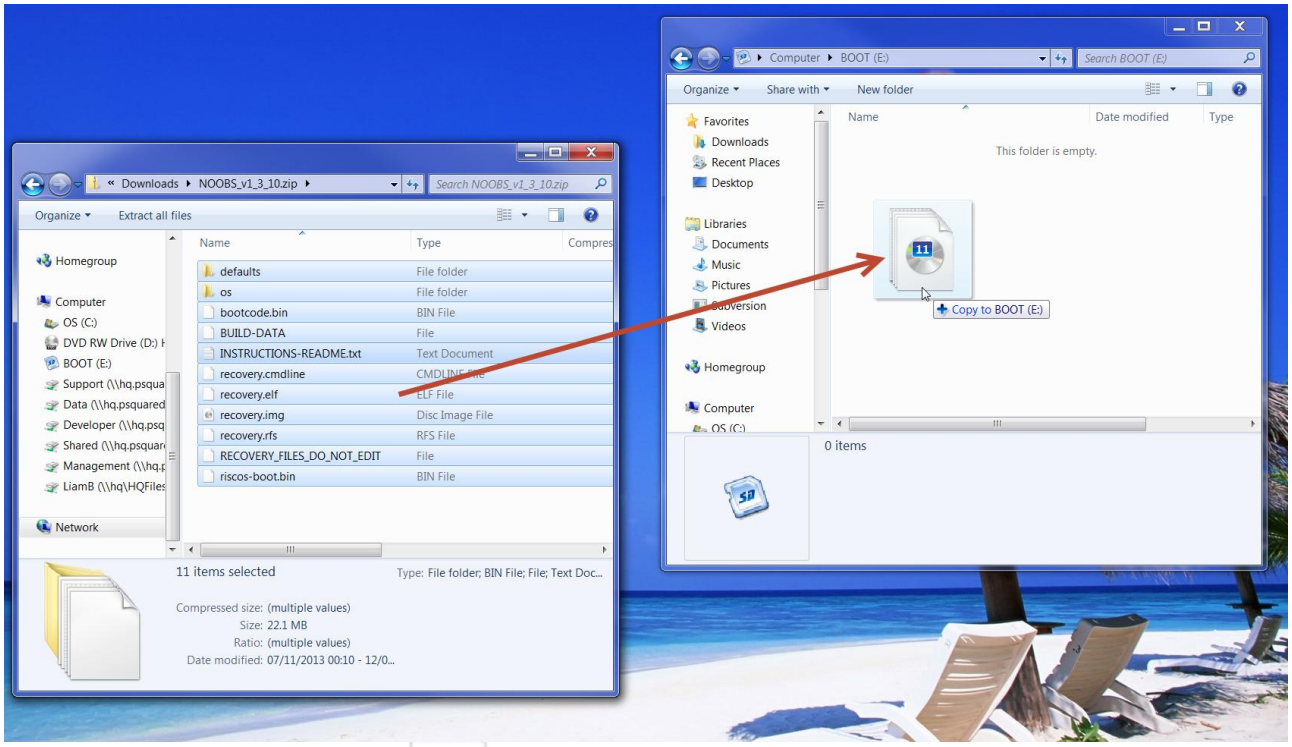
NOOBS standard for New Out Of The Box Software, and was developed by the Raspberry Pi Foundation to provide a simple to install Linux onto Raspberry Pi devices. The NOOBS package actually contains several different versions of Linux (called distributions) as well as hardware drivers for the Pi and popular software such as Scratch. In this case we are going to use NOOBS to install a standard Raspbian distribution on to our Pi.



Tip – It is more than 700mb so might take a while to download on some connections!

Once it has downloaded you will need to locate on your PC (usually the downloads folder) and open up the zip file by double clicking on it.

Next open a second My Computer window and navigate to you blank SD card. Select all of the files in the NOOBS zip and drag them onto the 'root' of the SD card (by this we mean not in any sub folder).



Alternatively you can copy all the files in the NOOBS zip and paste them in the root of the SD card to get the same effect.

Please note that you can bypass this step by buying an SD card with either NOOBS or Raspbian installed however, we would not recommend this as often the software on pre-installed SD cards is not the latest and you may well end up going through this process anyway so we recommend you save money and buy a blank SD card.

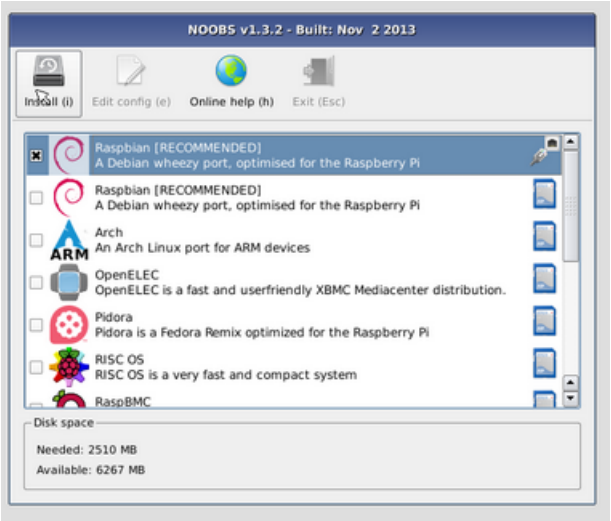
Step 2 – Setup Raspbian And Setting The Default Audio Output

Now that we have an SD card with the NOOBS package on it, it is time to setup the Raspberry Pi.

Here are the recommended steps:

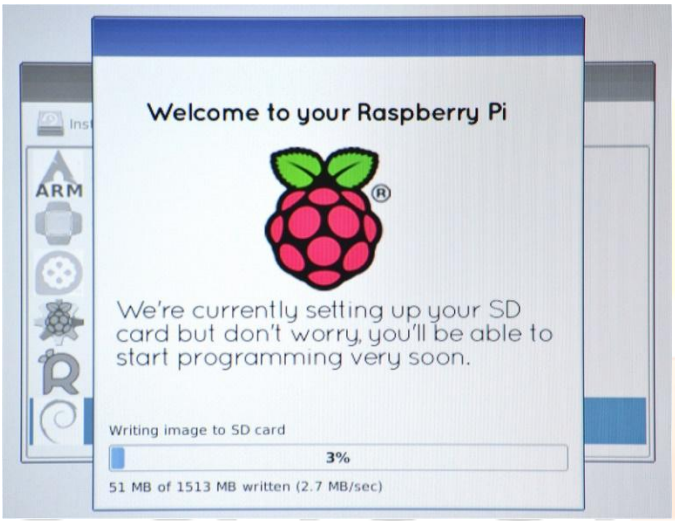
1. Plug a USB keyboard and mouse into your Raspberry Pi. You can use a USB hub if you need to plug more USB devices in but for now the keyboard and mouse are all you need.
2. Plug in an HDMI cable into the Pi and the other end into a TV or monitor (with HDMI input).
3. Plug a network cable (with web access) into the network socket on the Pi.
4. Insert your SD card into the Raspberry Pi (it can only go in one way).
5. Connect the micro USB power supply to the Pi and switch on the power.

After a few seconds you should see a multi-coloured display followed by some text on screen. A few seconds later you should see the NOOBS screen which allows you to select the Linux distribution that you want to install.



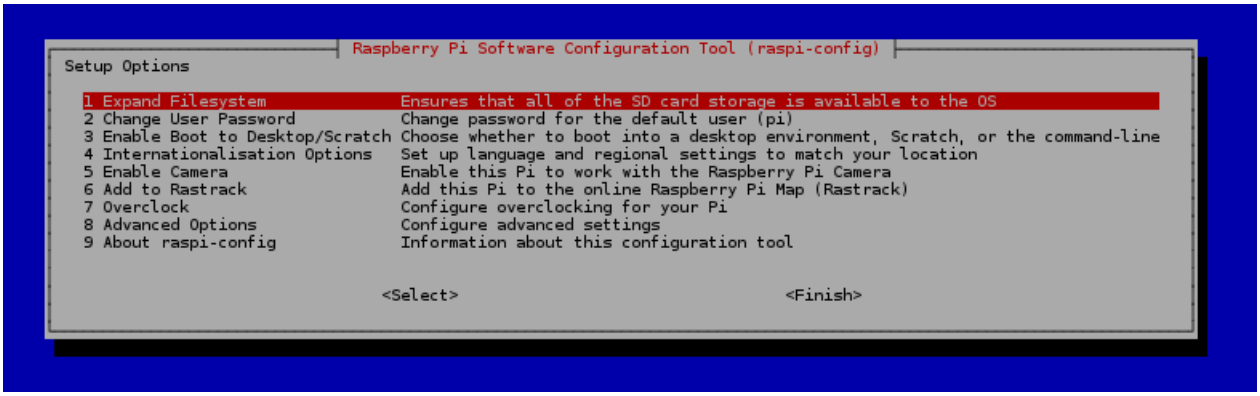
Select the Raspbian option and then click on the Install button.

Raspbian will now be installed onto your SD card (replacing the NOOBS file).



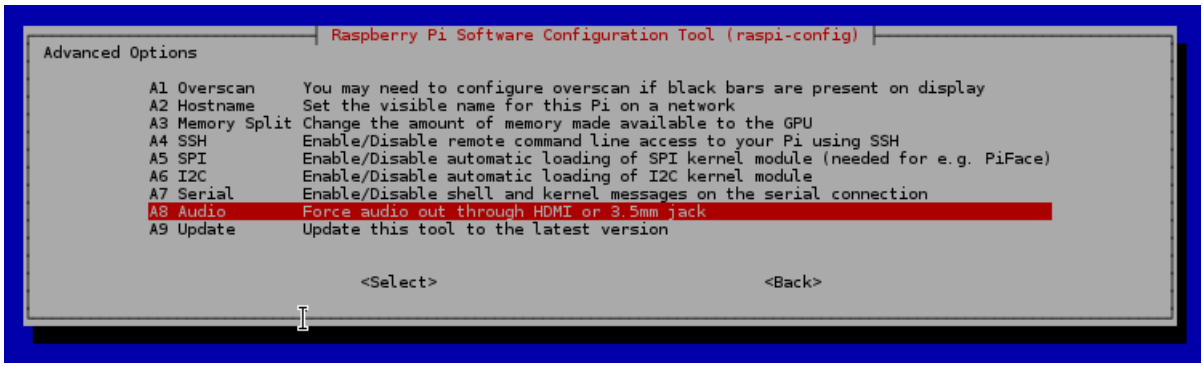
This can take some time so we suggest you go and make a cup of tea at this stage.

Once the installation process is finally complete, you will be presented with the Raspberry Pi Configuration window.

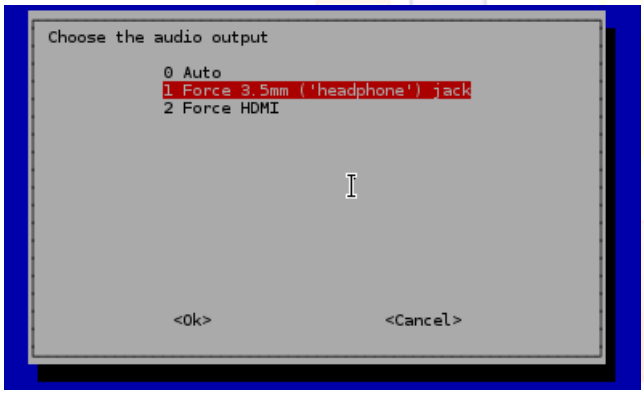


We will do two things in this window.

1. Use either the mouse or keyboard to select option 2 – Change User Password. This is not an essential step but all Pi's have the same default username and password (Username: pi Password: raspberry). If you are not concerned about people being able to access your Pi then you can leave them as the default but if you would prefer to secure access to your device then you should change the password to something more secure.
2. Select option 8 – Advanced Options. This will open the advanced options sub window. Here you will need to select option A8 – Audio as we want to set the Pi to output audio via the 3.5mm headphone jack.

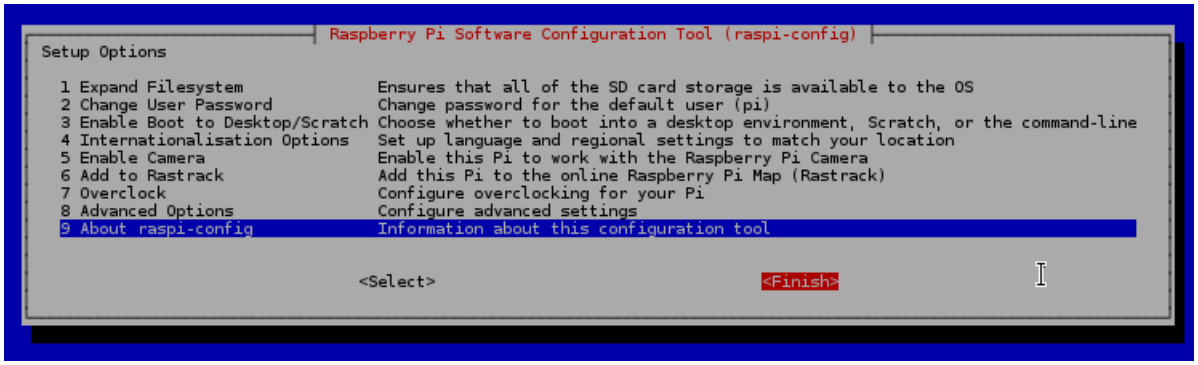


3. Finally, select option 1 – Force 3.5mm 'headphone' jack.



This will tell the PI to direct all sound out through the headphone socket as opposed to the speakers on your HDMI TV.

Select OK to return to the main menu and then select <FINISH> to save the changes.



Your Pi is now setup and we can move on to the next stage. You will see the command line prompt asking you to login.

Type in your login name and your password to get started.

Step 3 – Updating All The Software To The Latest Versions

This sounds like a big job but it is actually really easy. You need to type in the following command.

sudo apt-get update

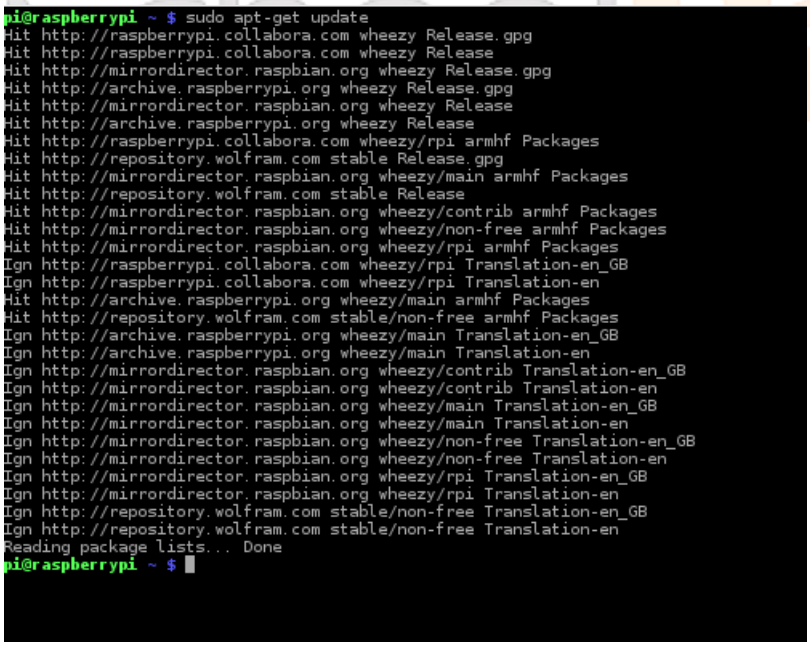
Explanation:

sudo – stands for 'super user do'. The default Pi login does not have security permission to alter any of the main Raspbian system files. This is a security measure built into Linux to stop malicious software (like viruses) from making changes without you knowing. By typing sudo at the beginning of a command, you tell the system to execute the command as a 'super user' that has sufficient rights to alter system files.

apt-get – The apt part of the command stands for Advanced Packaging Tool and is tool built into Raspbian that connects to an online list of available software that is available to be installed or updated for your Raspberry Pi. The 'get' section completes the command by telling the system it needs to get something from the Advanced Packaging Tool site.

update – The update part of the commands tells the system to download a new list of all the software available including the latest version number.

So when you type in *sudo apt-get update* and press return, the system will connect to the web and download the latest list of software and updates available. Obviously you will need web access in order for this to work.



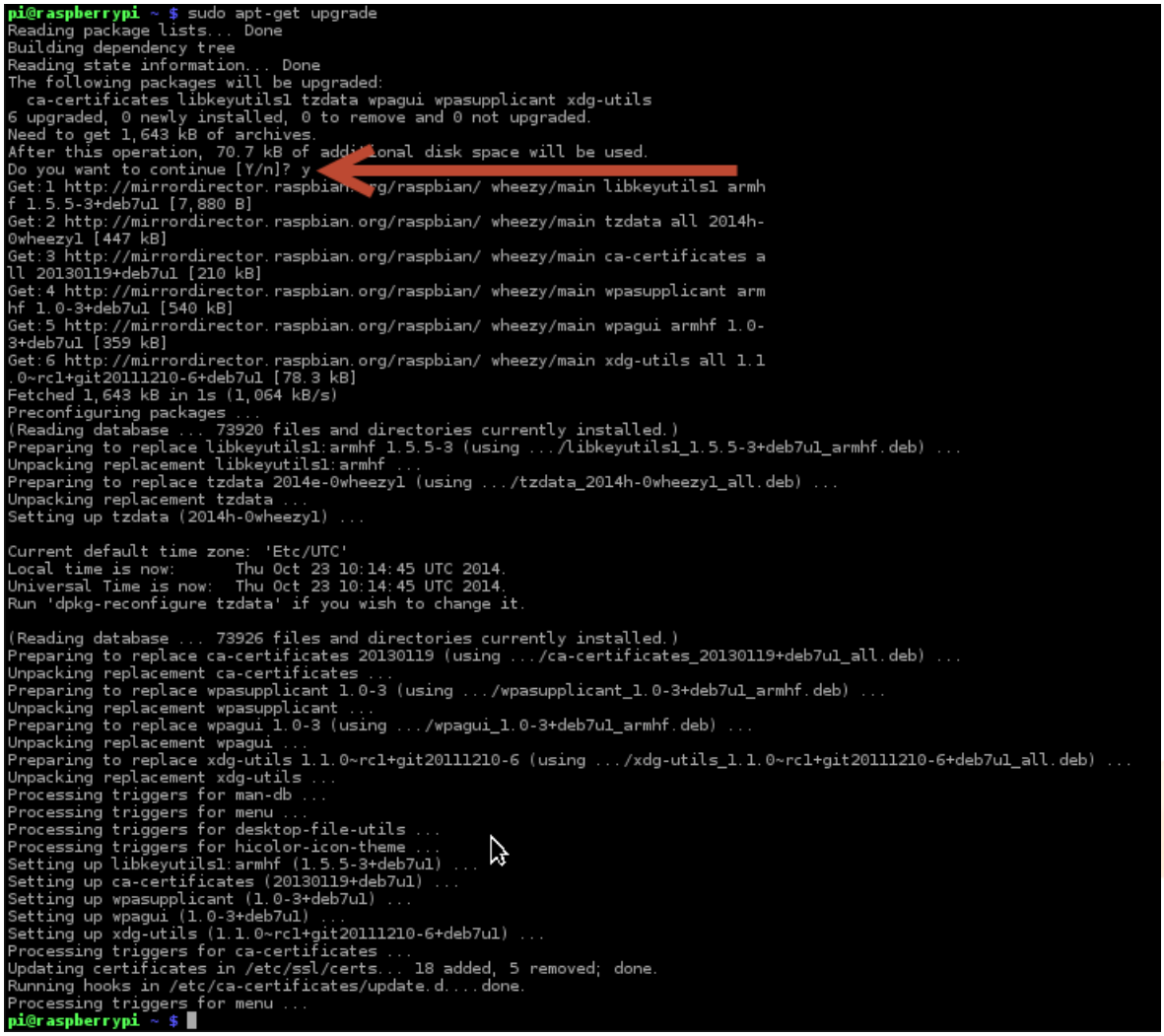
You should see something similar to the above if the command executes correctly.

Now that the system knows what the latest software available is, it is time to run another command to update anything that needs updating.

Type in the following command:

sudo apt-get upgrade

This is very similar to the previous command except we are now using the ‘upgrade’ extension to tell the system to install any new software updates it identified in the previous command.



In the example above, a few upgrades were found and the system calculated how much disk space this was going to use before asking whether we wanted to continue. Type ‘y’ and press <return> to continue with the upgrades. There is then a lot of technical information displayed on screen to tell you what the system is doing, you can ignore all of this as it is not important to understand what it is doing at this stage but by the time it has finished, all of your software will be updated to the very latest versions.

Once this is completed, you Pi is fully up to date and we are ready to install the Music Player Daemon software.

Step 4 – Install The Music Player Daemon Software

Now that everything is up to date with the basic system, it is time to install the software we will use to actually play the School Radio stream.

To do this we will use the apt-get tool to install the Music Player Daemon (MPD) and Music Player Client (MPC) software we need.

Type in the following command and press <return>

sudo apt-get install mpd mpc

Explanation:

sudo – As before, sudo tells the system to execute the following commands with 'super user' permission.

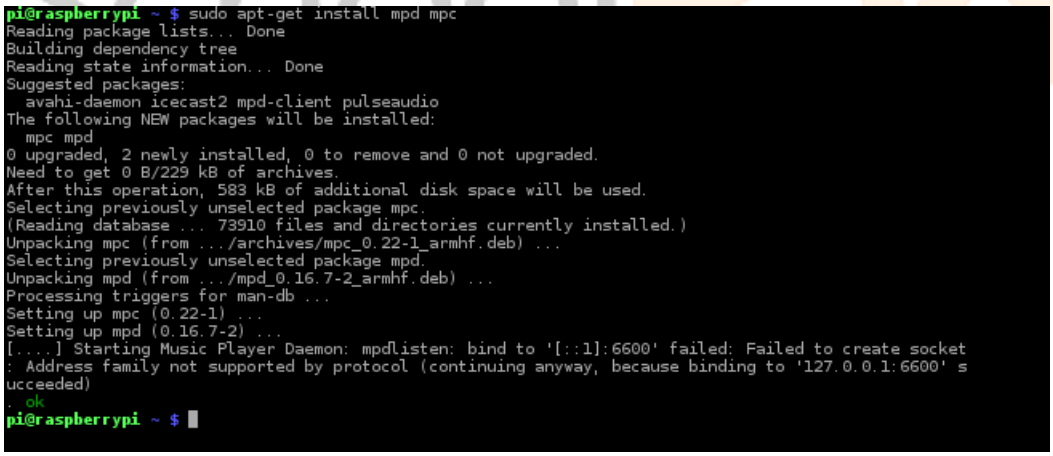
apt-get – Again, the apt-get section tells the system to use the Advanced Packaging Tool to connect to the online repository of software.

install – This tells the Advanced Packaging Tool that we are going to install some new software.

mpd – This tell the system to download the mpd (music player daemon) software and install it.

mpc – This tell the system to download the mpc (music player client) software and install it.

Note how we used a single command line to install two different pieces of software. We could have installed them one at a time but as Raspbian allows us to stack the installs in a single command, why make more work for yourself!



You may well see an error (as above) but don't worry it should still work ok. You have now installed all the software that we will need for our School Radio Player.

Step 5 – Configure The System To Connect To Your School Radio System And Play On Boot.

This is the final step in building our School Radio Player. All we need to do is configure the system to connect to address used to stream your School Radio station and instruct the system to play the stream whenever the PI is started.

For this you will need to get the location of the actual stream for your School Radio station.

You should have been given this information as part of your initial installation and it is the address you would type into a media player (like windows media player) in order to listen to the stream. It will be something like:

http://mp3streaming.planetwideradio.com:XXXX/XXXXXXX

With a unique number and station name appended to the end. For this example we will be using the following stream address which will connect to our generic School Radio test stream.

http://mp3streaming.planetwideradio.com:9340/SchoolRadioLive

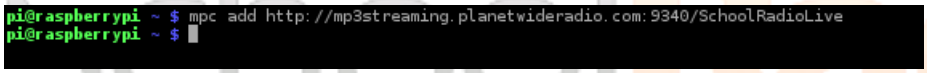
If you are not sure about this but you use School Radio to provide your streaming (via School Radio Player) then email sales@schoolradio.com and we will be happy to provide you with your stream address.

If you use a 3rd party to host your School Radio stream then they should be able to provide this information. The stream should be a shoutcast or icecast stream in MP3 format.

Once you have your unique streaming address, we are ready setup the School Radio Player to connect to your stream. Simply type in the following command.

mpc add http://mp3streaming.planetwideradio.com:9340/SchoolRadioLive

Make sure you type in the address carefully as it will not work if you get the streaming address wrong.



Notice we didn't need the 'sudo' command for this as it is not changing any important system files!

Explanation:

mpc – This tells the system we are using the Music Player Client.

add – And that we want to 'add' a stream location address.

http://mp3streaming.planetwideradio.com:9340/SchoolRadioLive - And this is the location of the stream we want to add.

So now we have told the system where the stream is, all that remains is to instruct it to start playing.

Type in the following command:

mpc play

This final command tells the system to start playing the stream.

You should see that it has connected correctly and if you plug in some speakers or headphones, you should be able to hear your radio station playing through the headphones.

Now that it is all working, we want to restart the Raspberry Pi and check to make sure it starts playing automatically. To do this type in the following:

sudo shutdown –h now

This will shut down the Raspberry Pi in the safest way possible. Once the screen turns off you are ok to unplug your Pi and then plug it back in to restart the system.

You Raspberry Pi should restart and return you to the login prompt after a few seconds but you should also hear your streamed audio start just after the login prompt appears meaning you do not have to login or even have a monitor, keyboard or mouse attached.

Congratulations, you have built a hardware School Radio Player!

More Advanced Stuff

This tutorial shows the absolute basics of setting up a School Radio Player but there are many more resources online to allow you to expand the project to include hardware volume controls, touch screen interfaces or building the whole thing into traditional radio cases. Some of our favourite projects include:

http://learn.adafruit.com/downloads/pdf/pi-wifi-radio.pdf

http://home.uktechreviews.com/Raspberry/Pi%20blog/files/RaspberryRadio.html

http://www.bobrathbone.com/raspberrypi_radio.htm

We would love to hear about what you come up with.

Other Things You Might Find Useful

The basic tutorial covers every step in building a very basic School Radio Player but in the course of researching and producing this tutorial we covered a number of additional areas that might prove useful. Explaining how all these work is outside the scope of this tutorial (but are all available online) but we thought it might be useful to include them for your reference.

Please note these guides assume knowledge of both Windows and Raspbian.

Giving Your Pi A Static IP Address

The basic tutorial assumes you are using DHCP on your network to assign a network IP address to your Pi. This is fine unless you want to manually assign an address to allow you to remotely access your Pi in the future.

1. See what your current network settings are by typing *ifconfig*

   This will show you the current network settings.

2. Make a backup of these settings using the following command:

   sudo cp /etc/network/interfaces /etc/network/interfaces.backup

3. With the backup made, it is time to edit the network settings using the following command:

   sudo nano /etc/network/interfaces

   This will open the command line text editor (nano) with the network configuration file.

   Find the line that says:

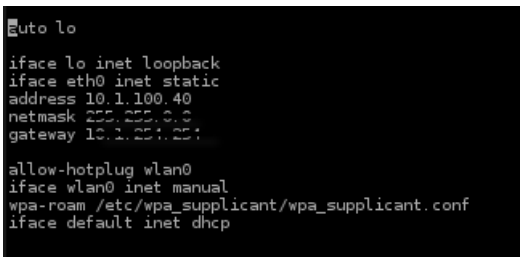
   iface eth0 inet dhcp

   and change it to the following:

   iface eth0 inet static
   address 192.100.x.x
   netmask 255.255.255.0
   gateway 192.100.x.x

   Where you add in your own static IP, netmask and default gateway addess.

   The finished file should look something like this.



   Press <Ctrl> + <X> and save when prompted (save over the top of the existing filename).

4. You will then need to reboot using

   sudo shutdown –r now

5. Once rebooted you should test to see if the network has been correctly setup by ping'ing the IP address of your Pi from another PC on the network.

Controlling Your Pi Via Remote Desktop

Once you have your static IP set you can control your Pi remotely from any Windows PC using the standard RDP client.

1. The first thing we need to do is install some software in the Pi to allow remote desktop clients to connect. As ever, it is recommended to get the latest list of software first using the apt-get update command.

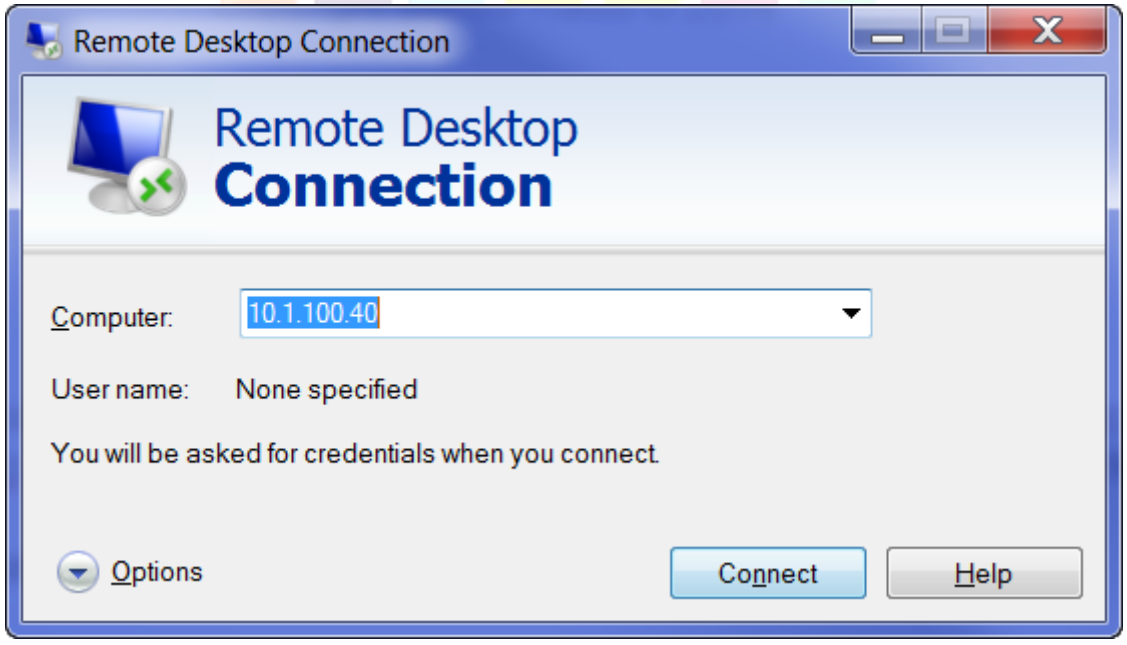
   sudo apt-get update

   This will download a list of the latest software to the system.

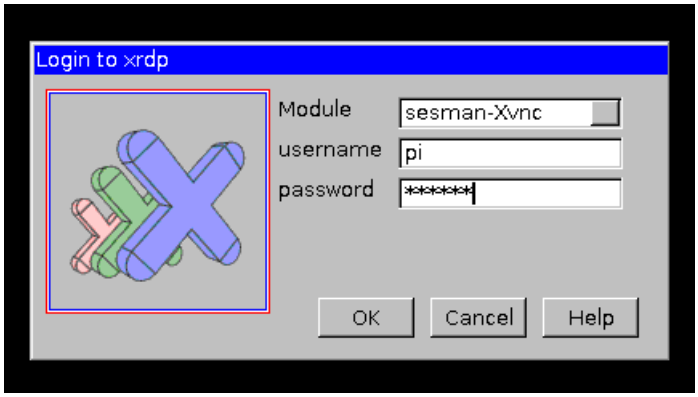
2. Now we need to download an application called XRDP using the following command.

   sudo apt-get install xrdp

3. Once this is installed you are ready to remotely control your Pi using the standards windows RDP client. Press the Start button and start typing 'remote desktop' and you should quickly see Remote Desktop Connection. Run this software and then type in the IP address for your Pi into the Computer section.



You will be asked whether you wish to connect to an unknown computer, say yes and then type in your Raspberry Pi username and password when prompted.



You will remotely control the user interface on your Pi. Use the LX Terminal application to access the command line terminal.