GREAT THINGS, SMALL PACKAGE.
YOUR UNOFFICIAL RASPBERRY PI MANUAL

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1. Intro To The Raspberry Pi

You've surely heard of the Raspberry Pi: the palm-sized computer with enough power to run servers or media centres complete with retro gaming; with the connectivity to control security systems and enthusiast projects; and with the software tools to encourage the teaching and understanding of programming.

Since its launch in 2012 the Raspberry Pi has exceeded expectations, becoming a must-have piece of computer hardware for enthusiasts and tech-heads. For a small project developed to be sold to schools and colleges to teach programming principles, that's not bad.

It's also just the tip of the iceberg.

In this guide you'll find everything you need to know about the Raspberry Pi computer, its background, purpose, system specs, the software it runs and the amazing things it is capable of.

1.1 What is the Raspberry Pi?

Under development since 2006, the Raspberry Pi is a small computer with the components mounted on a credit card sized motherboard, running a dedicated version of Linux.

Capable of offering basic office computing, low-level gaming, Internet and email access, media playback and many other features regularly expected from a computer in the 21st century, the Raspberry Pi achieves all of this with a stripped-down component count, an ARM processor and a very low price.

Costs are kept so low by selling the computer without cables, storage or a case. Cables and storage are of course vital, and if you decide that you need a case, there are various solutions available (see 3.1 Case Options).

1.1.2 Other Tiny Computers

You may be aware that the Raspberry Pi is not the only small computer project. Over the past few years a number of

stripped down, low-cost computers have been released for enthusiasts, in some ways echoing the golden homebrew days of the 1970s and 1980s.

Alternatives to the Raspberry Pi include:

- *The Arduino: geared towards providing a computer interface to electronics projects.*

- *ODROID: a slightly bulkier computer with the same processor as a Samsung Galaxy S3 smart-phone. This runs Android and Ubuntu operating systems.*

- *Gooseberry: currently unavailable, this device runs Android and is a little larger than the Rasp-berry Pi.*

Availability for these projects differs from the Raspberry Pi, which thanks to its low cost (and despite specs lower than ODROID and Gooseberry) has proven extremely popular. This is no doubt in part to the successful management of the supply and delivery chain, as well as the philosophy behind the device.

1.2 Ethos of the Raspberry Pi

The Raspberry Pi wasn't developed for you to enjoy retro games, create a MAME system or build a media centre: a far more noble cause is at its heart.

Designing and building a low-cost computer that is so flexible was the idea of a group of computer programmers such as Eben Upton and David Braben, both of whom are members of the Raspberry Pi Foundation. Their ethos for the creation of this computer was to develop hardware that children and students could use to learn about programming. The low cost of the computers means that they can be sold to schools around the world, thereby offering educational opportunities for all.

1.3 Some Uses for the Raspberry Pi

Enthusiasts around the world use the Pi for far more than its original purpose. Media centre software exists as a version of XBMC, and there are several Linux distributions that can be installed.

Retro gaming is possible (modern titles since around 2000 require far greater hardware resources) as is multimedia playback; remarkably the Raspberry Pi is capable of HD video. You might also use the device as a web server, NAS controller, home security computer… the possibilities are endless!

Later in the guide we'll be taking a look at operating systems and media centre software. Meanwhile, Section 8: Fascinating Uses for the Raspberry Pi provides an overview of many other uses for the computer.

2 What's Inside the Raspberry Pi?

For such a small computer you would probably expect the specs of the Raspberry Pi to be low. In some respects you would be right – but this device isn't so stripped back that you won't be able to gain some use from it.

Some components, such as storage, are left to the Raspberry Pi's buyer to deal with. Cables and even the device's case are not included when you purchase one of these devices new.

You'll be surprised at how much is available for the Raspberry Pi in terms of peripherals and storage, and this is largely due to the hardware options provided by the device and its system specification.

2.1 Raspberry Pi System Specs

There are two versions of the Raspberry Pi in circulation, Model A and Model B. There are slight differences between the two models.

	Model A	Model B
RRP	$25	$35
System on a Chip	Broadcom BCM2835	
CPU	700 MHz ARM1176JZF-S core	
GPU	Broadcom VideoCore IV, OpenGL ES 2.0. Device capable of MPEG-2 and VC-1, 1080p30 h.264/MPEG-4 AVC decoding and encoding.	
Memory (SDRAM)	256 MB, shared with GPU	512 MB (models build since October 15th 2012), shared with GPU
USB 2.0	1	2 (integrated USB hub)
Video Out	Composite RCA (PAL and NTSC), HDMI (also Display Serial Interface for LCD panels)	
Audio Out	3.5 mm jack, HDMI	
Storage	SD/MMC/SDIO card slot	
Network	No connector	RJ45 Ethernet through integrated USB hub
Peripheral connectors	8 × GPIO, UART, I²C bus, SPI bus	
Power rating	300 mA (1.5 W)	700 mA (3.5 W)
Power source	5 volt via MicroUSB or GPIO header	

A Raspberry Pi computer is 85.60 mm × 53.98 mm (3.370 in × 2.125 in), and around 15 mm deep. The unmodified Raspberry Pi without case, storage and cable connections weighs 45 grams, or 1.6 oz.

The Model B was originally released with 256 MB of RAM; other developments in the system specification should be expected as costs are reduced.

2.1.1 GPIO Warning

Although the use of the GPIO pins is beyond the scope of this guide, safety isn't. You will need to adopt the same careful approach to connecting to these pins as you would on any computer or circuit board, but more importantly they are 3.3V rather than 5V as found on an Arduino (a similar small computer more geared towards projects than software).

Without proper care, you could result in blowing up your Raspberry Pi's CPU as the GPIO pins are connected directly to this. Make sure you test the voltage through the cable before connecting to your Raspberry Pi!

2.2 Development of the Raspberry Pi

A prototype of the computer that would become the Raspberry Pi dates back to 2006, and the Raspberry Pi Foundation was formed in 2008, but it wasn't until 2011 that the possibility of the computer being released as a viable project became apparent.

Although now built in the United Kingdom, the original 10,000 boards were built in Taiwan and China in order to save on import duty. With over two million people requesting information about the computer or making pre-orders, the Pi went on sale on February 29th, 2012, an event that sent the Raspberry Pi website offline. As of September 2012, somewhere in the area of 500,000 of these compact computers have been sold!

3 What You Will Need for Your Raspberry Pi

As we've seen, the Raspberry Pi ships as-is. When you open the box, all you will find is a small motherboard with the required components attached. It's up to you to finish the job with cables, a case and storage media.

Cases for this device come in all shapes and sizes, from Lego self-builds to downloadable cardboard cutouts. In addition to a case, you'll need certain cables to enjoy your Raspberry Pi, as well as storage, typically an SD card. Let's explore your options.

3.1 Case Options

The first thing you will notice about a brand new Raspberry Pi is that it ships without a case. This is a little similar to running a PC motherboard without bothering with the tower – unwise! The solution, of course, is to find or build a case. Many are available, so let's go over a few.

3.1.1 Punnet Case

The Punnet case is a popular option, being as it is completely free and easy to construct. It exists as a printable design that can be cut out and constructed in thick paper or card, providing a home for your Raspberry Pi computer.

3.1.2 Lego

There is little that you can't build with Lego, and a case for the Raspberry Pi is not an exception. As with any DIY case for this computer, you will need to make sure that there is sufficient space for the cables and storage card and that the case offers sufficient venting. You can use the Punnet case design to help with the positioning of these gaps.

3.1.3 Hobby Cases

Various hobby case solutions can be purchased for electronics projects, and it shouldn't take you too long to find something with the right dimensions for the Raspberry Pi (see above). The Revision 2 of the Raspberry Pi is also equipped with a couple of mounting holes, which should be taken advantage of. You can find their position via this template from Raspberry Pi Spy.

In addition, there are various cases you can purchase, from outlets such as:

- http://pibow.com/

- http://www.piholder.com/en/

- *You can also – remarkably – purchase a Lego kit for your Raspberry Pi from* http://www.thedaily-brick.co.uk/lego-sets/custom/lego-custom-raspberry-pi-case.html

3.1.4 Upcycle Old Hardware

Handheld game consoles like the Nintendo Gameboy, old routers, keyboards and even video game cartridges (specifically those for the Nintendo 64) can all be used as housings for the Raspberry Pi. A certain amount of planning will be required, and you will need to have the right equipment to hand to make the conversion possible. Old toys and music players can also be reconfigured to hold a Raspberry Pi.

There are many more ways in which you can put your Raspberry Pi in a case – this is just the tip of a very sweet and pastry-capped iceberg!

Whichever case solution you use, make sure that it is sturdy, will protect the Raspberry Pi from knocks and offer the necessary airflow for keeping the processor cooled.

3.2 Cables

In order to get the best from your Raspberry Pi, there are several cables that you will need:

- *Ethernet – if you don't plan on using a Wi-Fi adaptor, you will need this to connect to your router.*

- *HDMI cable – remarkably, the Raspberry Pi has a single HDMI port, for high definition video and audio.*

- *Audio cable – a standard jack for connecting your pocket-sized computer to an audio system. This is useful if you're not using HDMI, or want to send your audio to a different device.*

- *RCA Video cable – an alternative video out (at a low resolution) for use with displays without HDMI.*

Cables aren't everything, however…

3.3 Storage

One of the most important elements of any computer is the storage, from where the operating system is run and data stored. The Raspberry Pi doesn't have a hard disk drive – instead, it is equipped with a SD card reader.

You should aim to purchase a high rated SDHC card for use with this mini-computer. Capacity should be 2 GB or more – more storage offers the best results. The Raspberry Pi uses the storage much like a solid-state drive, which is why the SDHC format is used for its improved read/write resilience.

Additional storage can be attached via the USB ports.

3.4 Everything Else

There are a few other things that you will need for the Raspberry Pi to work.

- *USB keyboard and USB mouse – pretty vital if you plan on entering any text or using the configuration menus. After the device has been set up and networked, you can use the USB ports for other purposes (such as additional storage or wireless networking), entering text commands via SSH.*

- *5 volt via MicroUSB adaptor. The type used by Blackberry phones is popular, reliable and easily affordable.*

3.5 Handle with Care

Whatever you're planning to do with your Raspberry Pi, make sure you give it the respect it deserves. It may be small, but it is just as prone to damage from static electricity and knocks and blows – not to mention extremes of temperature – as any other computer.

As such, you should remove all jewellery and static-attracting garments (nylon and other man-made fibres, as well as wool), handle the device in a clean, dust-free area with a solid, non-carpeted floor and make sure that you have clean hands and have earthed yourself.

Once your Raspberry Pi is suitably protected in its box or case, you can then continue to use it much as you would any other device. However, starting up and shutting down can prove problematic (particularly the latter) – see section 5.1 Start and Shut Down Safely for more details.

4. Setting Up the Raspberry Pi

With the correct cables and storage prepared you'll be able to install an operating system on your Raspberry Pi. Due to the hardware profile, however, this isn't a device that will run Windows or Mac OS X. Instead, you will need to rely on a Linux distribution.


There are several distros available for the Pi, but the most popular is Raspbian, a cleverly named Debian port configured specifically for the Raspberry Pi. Installing this can be tricky if you don't follow the instructions, and like any OS installation on the Raspberry Pi it requires additional software to make your SD card bootable.

Other distros can be downloaded and installed on the Raspberry Pi, but the most interesting of these is Android. Let's not get ahead of ourselves, though: keep reading to find out how to install Raspbian.

The following steps are for setting up the software on Windows. Linux users can write to the SD card with the dd tool, while Mac OS X users can also use dd or RPi-sd card builder utility. Full instructions for these platforms are available online.

4.1 Installing Raspbian

To get started installing Raspbian, visit Raspberry Pi Downloads and download the latest version. You will also need Win32 Disk Imager. With both downloaded, unzip Win32 Disk Imager and insert your card into the card reader.
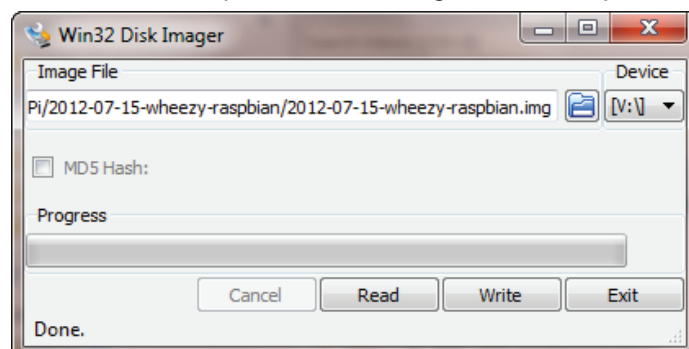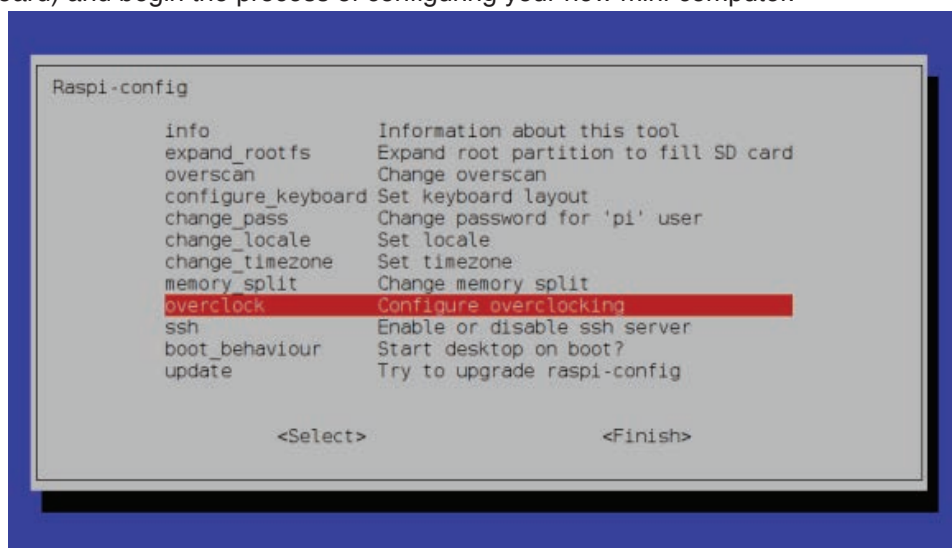

Run the utility and select the correct drive letter (check in Windows Explorer) and click the file icon to browse to the directory where you have downloaded your latest Raspbian build.

To start installation, click Write and wait. When the process is complete you will be notified.

Your Raspberry Pi is ready to go!

4.1.1 Using Raspi-config

Once Raspbian is installed, you will be able to insert the SD card, power up your Raspberry Pi, connect the HDMI cable (and a keyboard) and begin the process of configuring your new mini-computer.

```
Raspi-config

    info                Information about this tool
    expand_rootfs       Expand root partition to fill SD card
    overscan            Change overscan
    configure_keyboard  Set keyboard layout
    change_pass         Change password for 'pi' user
    change_locale       Set locale
    change_timezone     Set timezone
    memory_split        Change memory split
    overclock           Configure overclocking
    ssh                 Enable or disable ssh server
    boot_behaviour      Start desktop on boot?
    update              Try to upgrade raspi-config



            <Select>                    <Finish>
```

This is done with a utility called Raspi-config, which appears when you boot the Raspberry Pi for the first time.

You can change the options in this menu using your arrow keys, space bar and Enter key. The following table explains what each option configures.

info	Explains the point of the Raspi-config tool
expand_rootfs	Allows you to use the entire SD card for the operating system on larger cards.
overscan	Removes the black border that you might see on your display. Can be reinstated by editing /boot/config.txt
configure_keyboard	Default language is UK English
change_pass	Default login is username: pi and password: raspberry. You should change the password after setting up.
change_locale	This can take a while to open, the default setting is en_GB UTF-8 UTF-8. If you're in the USA you will need to change this.
change_timezone	Another slow menu, select your continent to reveal a list of cities.
memory_split	Three splits are available, apportioning 32 MB, 64 MB or 128 MB for the video core. Default option is 64 MB; 128 MB is most suitable when running XBMC.
overclock	Unless you understand the risks of overclocking you should probably avoid this option. Misuse can result in crashes and freezes.
ssh	Enabled by default, you can connect to your Raspberry Pi command line via SSH from another computer.
boot_behaviour	Do you want the computer to boot to desktop or command line? Make your choice here.
Update	Upgrades the Raspberry Pi.

The first thing you should do on your first launch of the Raspberry Pi is to run the Update. Make sure you have an Ethernet cable attached as the update will grab files form the Raspbian servers.

Raspi-config can be launched at any time from the command line with the command **sudo raspi-config**.

4.1.2 Controlling the Raspberry Pi with SSH

Achieving "headless" use of your Raspberry Pi – using it without a dedicated monitor – is achievable using SSH.

As this is enabled by default, you don't even need to do anything with Raspi-config to set it up. As long as your Raspberry Pi is connected to the same network as your computer and you have an SSH utility such as PuTTY, available from http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html, running, you should be able to connect via

SSH in seconds.
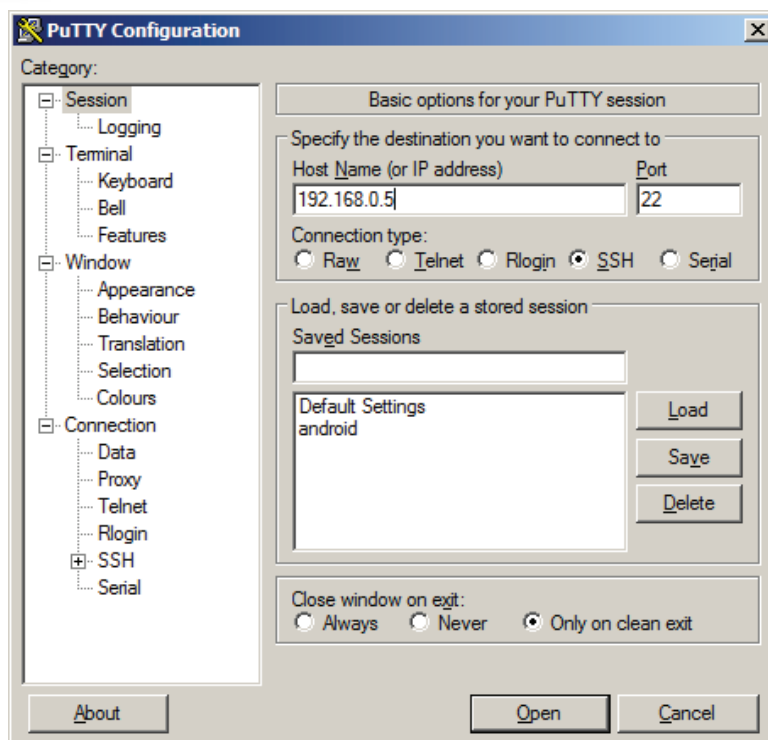
Configuring PuTTY is straightforward: in the **Session** screen, add the IP address of the Raspberry Pi in the **Host Name (or IP address)** field. Ensure SSH is selected and click **Open**. You can login to your Raspberry Pi using the credentials provided by your chosen distro (for instance if you use Raspbian, the username and password are displayed on the Raspbian download page).

4.2 Other Distros

Raspbian is the most popular choice for Raspberry Pi owners, but is by no means the only distro available for the computer.

You will also find:

- *Debian "Wheezy": a slightly different build to the Raspbian, this is intended for use with Java.*

- *Arch Linux ARM: based on Arch Linux, this distro boots in 10 seconds, but is unsuitable for most beginners.*

- *RISC OS: available free of charge to Raspberry Pi uses (RISC usually requires a license) this is the modern version of the British operating system developed in Cambridge and found on old Acorn computers.*

- *Moebius: a stripped-down operating system designed for projects requiring none of the bloat found on a standard OS.*

Head to http://www.raspberrypi.org/downloads to get the most up-to-date links for these regularly updated distros.

4.3 Android for Raspberry Pi

There is one other operating system available for the Raspberry Pi. Unsurprisingly it is the world's most popular ARM-based OS: Android!

While this allows the installation of many Android apps and games, the currently compatible version of the popular mobile OS is a couple of years behind. At present only Android 2.3 will run on the Raspberry Pi.

Future development of Android for the Raspberry Pi will hopefully bring Ice Cream Sandwich or Jelly Bean to the platform, but completion seems a long way off at present.

4.3.1 Installing Android on Your Raspberry Pi

Installing Android onto the Raspberry Pi is just as easy as installing Raspbian. Begin by downloading CyanogenMod 7.2, a custom Android ROM designed specifically for the Pi.

Once again, Win32 Disk Imager is required, so download and unzip, then run. With an SD card inserted into your card reader, select the correct device and browse for the Android ROM. Once selected, click Write to begin installation.

As with Raspbian, when the installation of Android is complete, close the utility, safely eject the SD card and insert into your Raspberry Pi. Switch on and Android will be running!

5 Getting to Grips with the GUI

There are two ways to use the Raspberry Pi. The first is to rely on the text-driven user interface, which is ideal for particular tasks. Alternatively, there is the second option, using the mouse-driven GUI, which will be far more familiar to most users.
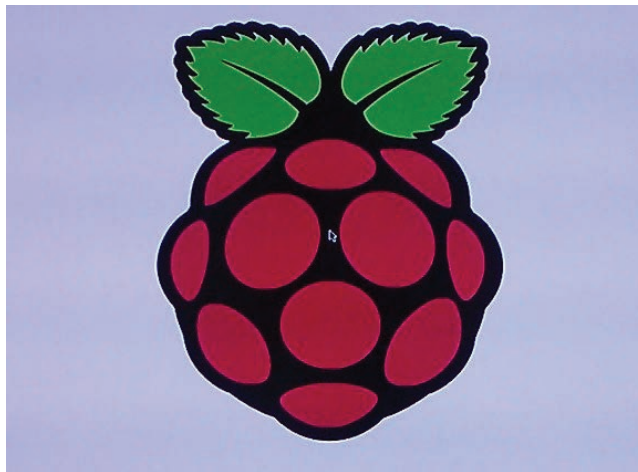
As you should be aware if you've read the guide to this point, the Raspberry Pi's Raspbian operating system is based on the Debian distribution of Linux. As such, you will have a particular advantage if you are familiar with Linux. If not, the basics are extremely easy to get to grips with, from text-based menus used for configuring your Raspberry Pi to adding new software.

5.1 Start and Shut Down Safely

The first time that you boot the Raspberry Pi, you will find that it boots to a configuration menu. This is used for setting various options that will determine how the computer behaves and also offering update tools.

You might be interested in bypassing this menu. This can be done by selecting the boot_behaviour option and making the necessary selection using the arrow keys and Enter (further details about the configuration menu can be found in section 4.1.3.). Alternatively, you can launch the GUI by entering:

```
startx
```

Thanks to the SD card that is used as a storage device in the Raspberry Pi, switching the computer off by disconnecting the power cable or unplugging at the mains will more than likely corrupt the OS, preventing you from being able to reboot. In this situation, a reinstallation will be required.
To avoid this, you should use the provided shut down menu option. In the command line, this is done by entering:

```
sudo shutdown -h now
```

There is also a shutdown option from the desktop.

5.2 Issuing Instructions in the Command Line

Although running the Raspberry Pi with the GUI desktop rather than the text-based command line is probably preferable in many situations, as with any Linux distro there will be times when you need to use the command line option to issue instructions.

In order to do this (for instance, to shutdown the device), you will need to open the command line from within the StartX GUI.
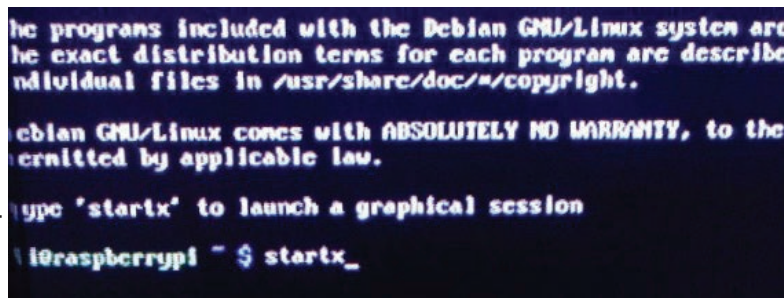
To get the most out of a Raspberry Pi running a Linux distro such as Debian, you will need to become more familiar with the principles of the operating system. Our Newbie's Getting Started Guide to Linux is a great place to start.

5.3 Adding New Software

There are two main methods for installing software onto your Raspberry Pi. The first is the traditional Linux route of downloading and installing from a remote server, known as a repository. This is done from the command line:

```
apt-get update
apt-get install <softwarename>
```

Since the release of the Raspberry Pi, a new tool has been provided for installing software. The Pi Store features applications and utilities designed specifically for the computer. This needs a client to be useful, however, which you must add from a repository with the following command:

```
sudo apt-get update && sudo apt-get install pistore
```

Software available from the Pi Store (which you can view online at http://store.raspberrypi.com) is optimised for the Raspberry Pi, and all settings are preconfigured, enabling "silent", interaction-free installs.
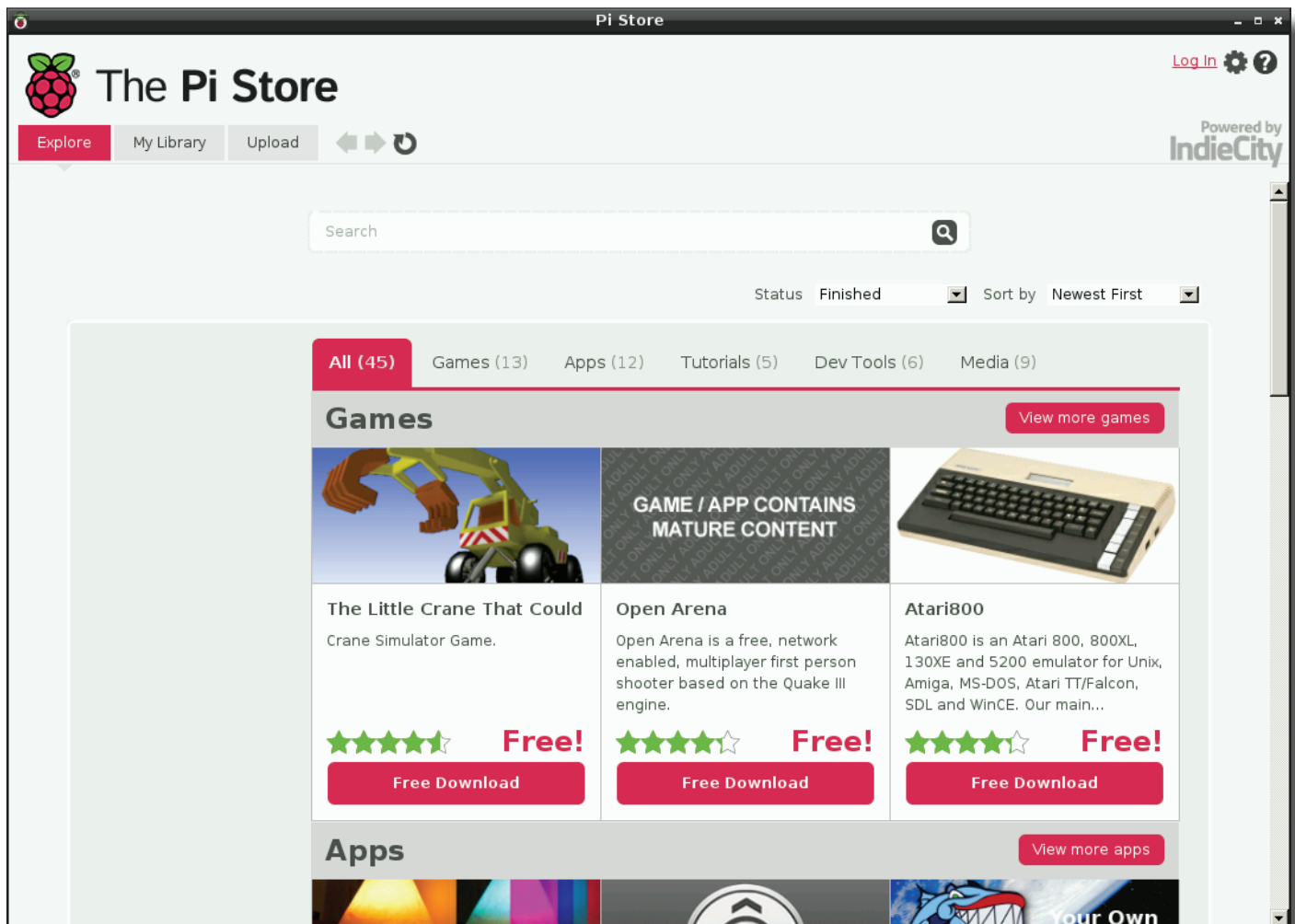
6. Programming on the Pi

One of the key reasons for the development of the Raspberry Pi was to create an affordable computer that children and students could use as a platform for application development. Programming on the Pi is made simple by the provision of various tools, available bundled in with the Raspbian operating system.
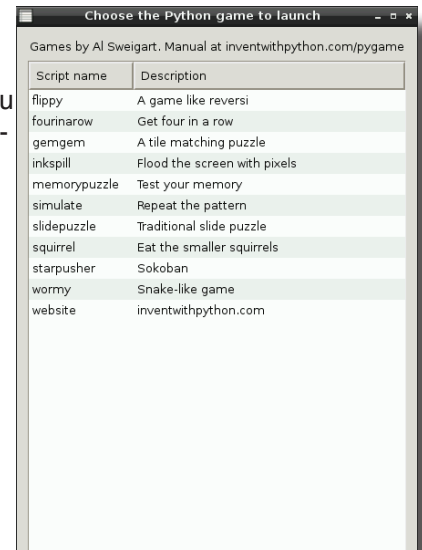
Whether you're happy learning to program applications with Python or you prefer one of the alternatives that can be installed, you'll need a plan or outline for your application, plenty of time to spend getting it right and some basic background in coding.
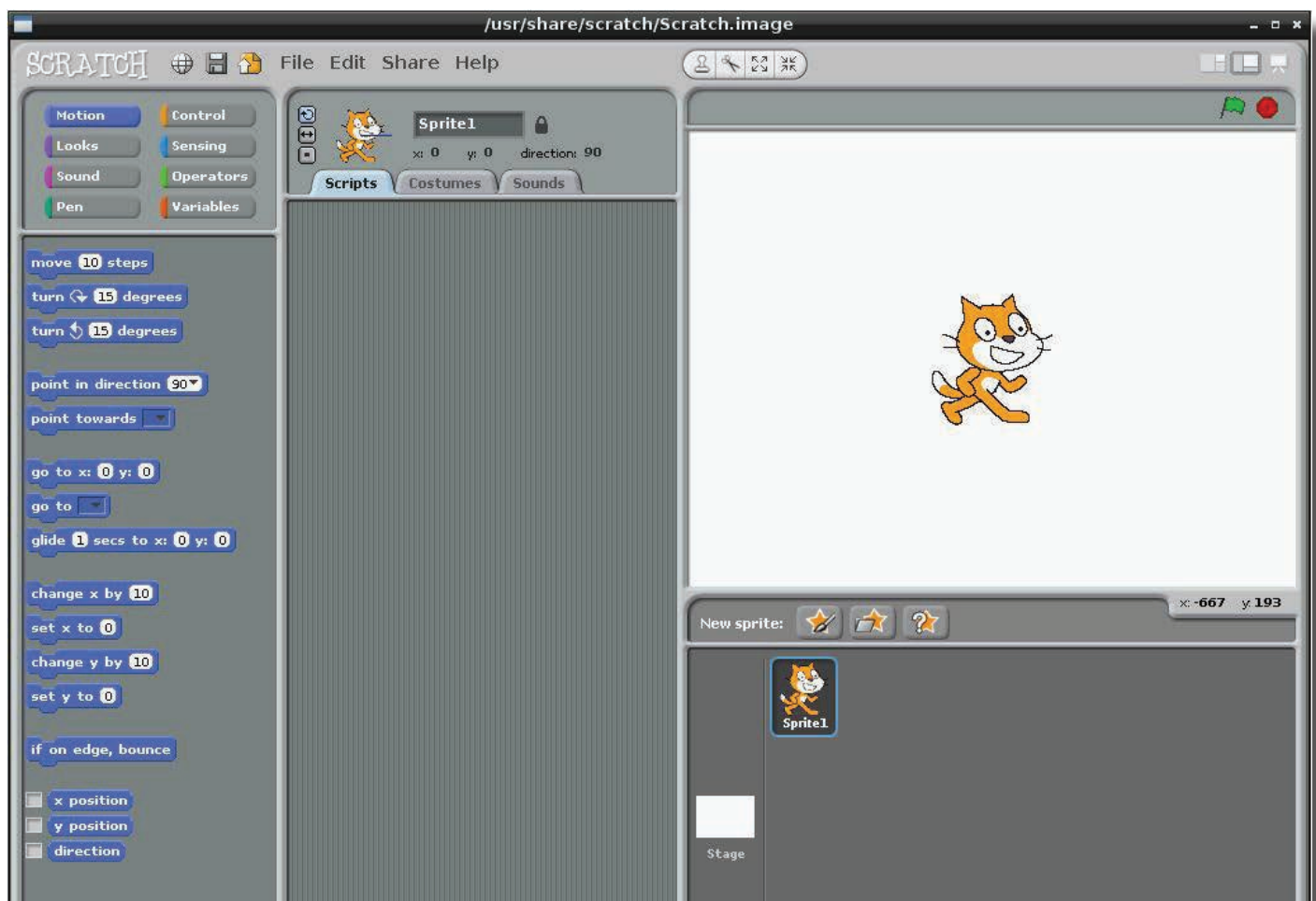
6.1 Python

The primary programming language provided with the Raspberry Pi is Python. If you have experience with this language then you should be able to start coding straight-away.

Of course, if you're 7, the chances are that you haven't had the time to get to grips with Python, what with collecting worms and buying sweets. Fortunately, the Raspberry Pi ships with a useful Python module called Pygame, essentially a game construction kit that should enable you to have fun and learn basic game building principles at the same time. There are also several programs included that have been written in Python, so you can get an idea of what can be achieved.

Note also that Python is a cross-platform scripting language, which means that you can program on a Windows computer or a Mac, save the project and then run it on your Raspberry Pi.

Choose the Python game to launch

Games by Al Sweigart. Manual at inventwithpython.com/pygame

Script name	Description
flippy	A game like reversi
fourinarow	Get four in a row
gemgem	A tile matching puzzle
inkspill	Flood the screen with pixels
memorypuzzle	Test your memory
simulate	Repeat the pattern
slidepuzzle	Traditional slide puzzle
squirrel	Eat the smaller squirrels
starpusher	Sokoban
wormy	Snake-like game
website	inventwithpython.com

6.2 Other Programming Tools

Although Python is considered the core programming tool for young users of the Raspberry Pi, other languages can also be used:

- *Java has been tested, although the resulting program may not run until Oracle releases the JVM for the Raspberry Pi, expected sometime in 2013.*

- *PHP can also be successfully used, opening up some interesting possibilities for using this mini-computer as a web server.*

- *Scratch is included in the Raspbian distro, an easy to use development tool aimed at children with a drag-and-drop GUI that makes building conditions and in-game situations extremely simple. Scratch is developed by MIT Media Lab and Lifelong Kindergarten Group.*

- *Projects using the GalaxC, Lazarus and Groovy languages can all be compiled and tested on a Raspberry Pi.*

6.3 Where to Find Tips on Coding

Python is a widely used programming language, and you can find plenty of tips for use across the web. Your best starting point, however, should be the Python website where a good deal of material is on offer, including a tutorial and various reference guides.

The tutorial is quite comprehensive, so you will need to put plenty of time aside for going through it. Reference guides are also provided explaining the various libraries and the functions in each, enabling you to get a grasp of what can be done with this language.

Head to http://docs.python.org/3/ to begin your Python tutorial.

While Scratch might appear to be quite self-explanatory, you can get support and see other projects by visiting http://scratch.mit.edu/.

6.4 Raspberry Pi in Schools

As you learned earlier, the Raspberry Pi was conceived as a computer that pupils and older students could use for programming in schools. But how successful has this aim been?
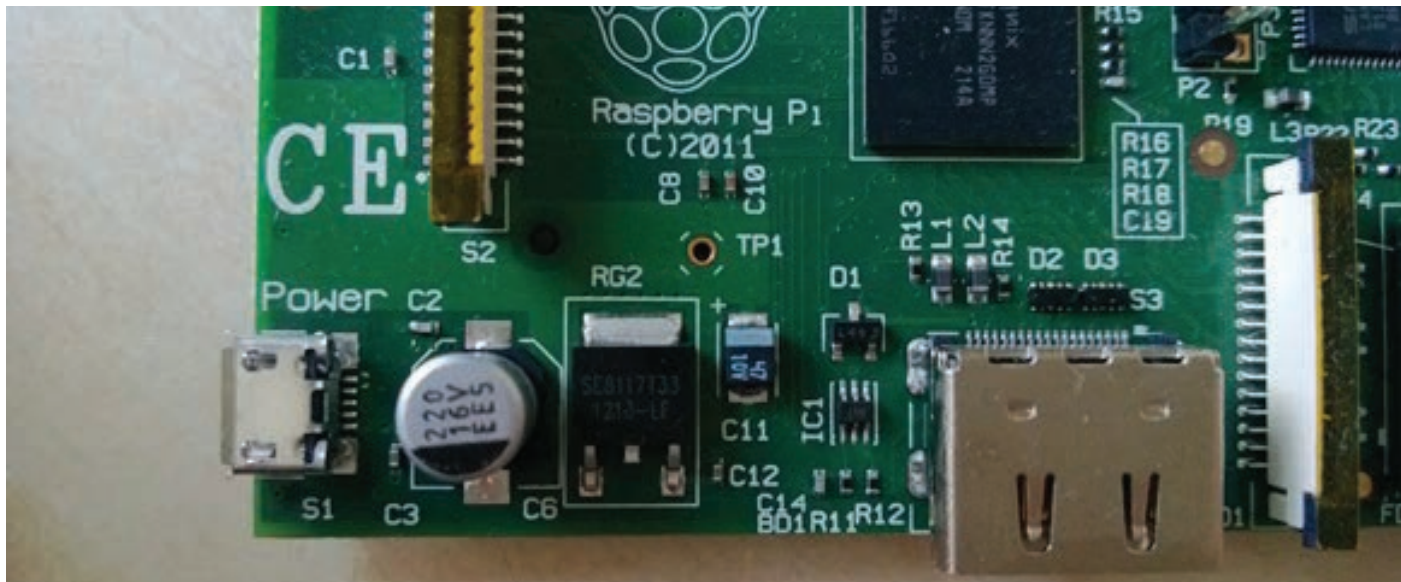
Unfortunately there are no explicit figures, although there are accounts of schools making bulk purchases and people buying the devices to donate to education facilities. It is estimated that around 20% are in the hands of children, and there are likely to be many more young people who have a Raspberry Pi in the family.

What is concerning, however, is that some schools may be ill-prepared to deal with teaching on the Raspberry Pi. Fortunately there is a useful Creative Commons licensed manual produced for UK educators, CAS Raspberry Pi Educational Manual, which can be downloaded via the Raspberry Pi website and through the integrated app store.

7. Using the Raspberry Pi as a Media Centre

Arguably the most popular use for a Raspberry Pi is as a media centre. Why splash out $$$ on a smart TV when you can get everything you need for under $40?

Thanks to the USB ports and networking, a Raspberry Pi makes an excellent media device, both as a small set-top box streaming media from a larger PC or the web and as an all-in-one unit, accessing external hard disk drives and other storage media and outputting the media to your TV or sound system.

In order to do this, however, you will need to install a special version of XBMC, known as Raspbmc.

7.1 Installing XBMC on the Raspberry Pi

In order to turn your Raspberry Pi into a media centre, you will need to install Raspbmc, an alternative operating system for your Pi that's centred around the XBMC media player. This can be downloaded from http://download.raspbmc.com/downloads/bin/installers/raspbmc-win32.zip and will need to be installed to SD using the same process used for installing Raspbian (see 4.1 Installing Raspbian).

Ideally you should use two SD cards, one for your Raspberry Pi's usual operating system and a second for XBMC. This way you can swap between roles as easily as switching the cards over, making the little computer even more flexible.

The following steps are explicitly for Windows users. Writing to the SD card on Linux and OS X requires command line access, although the process is virtually identical on each. Details on how to do this can be found on the OS X/Linux Installation guide at the Raspbmc website.

Installing Raspbmc for the Pi is as simple as installing the basic operating system. Begin by downloading the Raspbmc installer; once this is downloaded, connect an empty, formatted SD card into your reader before unzipping and running **installer.exe**.
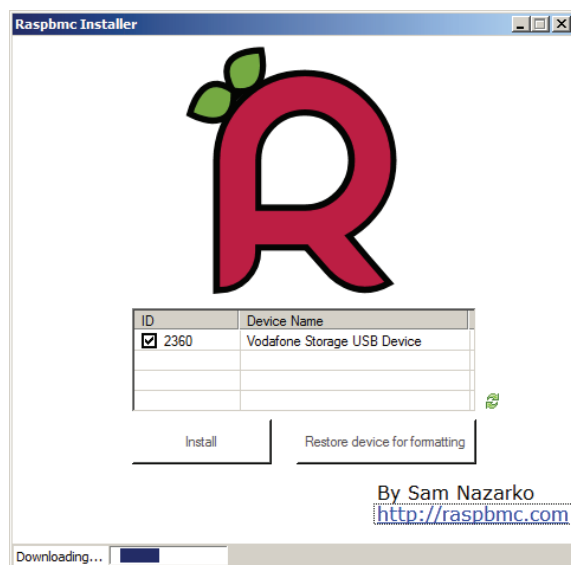
Your SD card should be detected. Check the box against it and select Install, then wait. When the process is complete you will be informed, at which point you should close the installer utility, carefully remove the SD card and insert it into your Raspberry Pi.

With the Ethernet cable connected, switch on the Raspberry Pi. The device will connect to the Internet to download further data, and once complete it will boot into the Raspberry Pi port of XBMC – your pocket-sized media centre is ready!

7.2 Principles of Running XBMC on a Raspberry Pi

Although setting up XBMC on the Pi is relatively easy, and getting started for viewing videos and enjoying music is

simple, using the Raspberry Pi as a media centre is a little different to the usual setup.
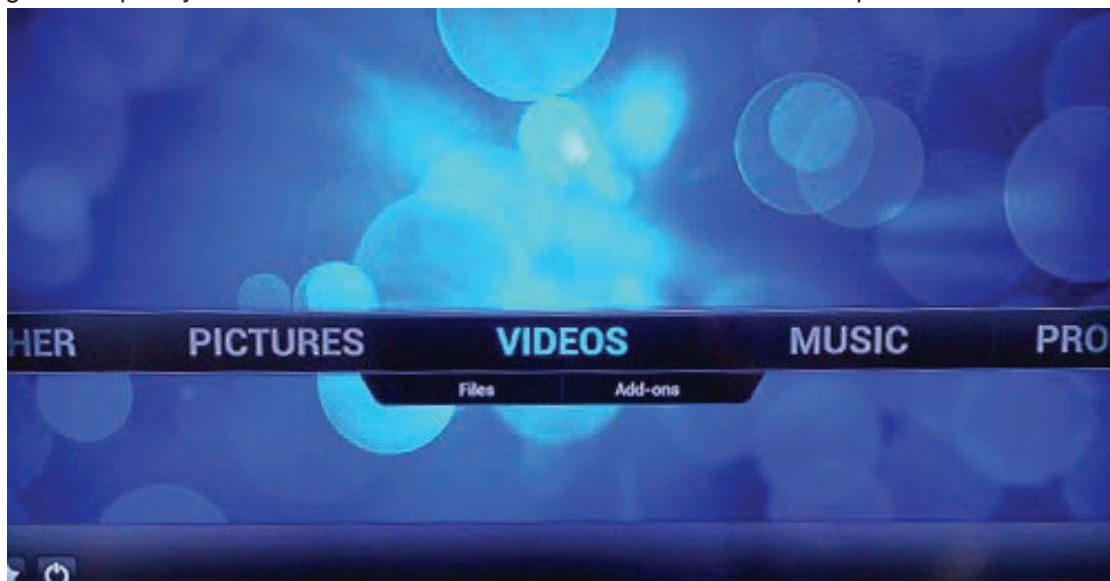
Unless you're using an extremely large capacity SD card (SDHC with a maximum of 32 GB is the recommended format, although some types of SDXC are believed to work) you will need to run media from an external hard disk drive, a USB storage device or an external optical drive. XBMC offers various streaming options thanks to its wide selection of add-ons, of course… it all really depends on your preferred media choices. You should also consider a powered USB hub if you're planning on maxing out your existing expansion options.

A network attached storage box might be one solution for media stored on HDD, for instance, or you might rely on sharing content across your home network from a PC in your office, bedroom or den.

One thing to be aware of is that Netflix will not run on the Raspberry Pi (at the time of writing) due to its reliance on Microsoft's Silverlight. This is something that Netflix hasn't yet commented on, and with around one million Raspberry Pi devices sold by early 2013 it seems unlikely that this will be the case long-term.

A final point on using the Raspberry Pi as a media centre: this is one use where you will really find the device gets some wear and tear, so make sure you have a versatile and hardy case for the computer!

7.3 Extending XBMC

Installing Raspbmc is only the first step in setting up your media centre. A variety of add-ons enable you to extend this software considerably, many of which we've covered on MakeUseOf. For instance, you can watch the news online using XBMC, add podcast feeds to XBMC and enjoy YouTube videos. Additionally, you can re-skin the interface, and even watch Hulu – not to mention enjoy free cable and sport, piped directly to your TV from the Internet!

Of course, there is much more that you can do with XBMC – we feature regular articles on MakeUseOf on this subject, so keep an eye out for more in the future.

8. Fascinating Uses for the Raspberry Pi

While running a Raspberry Pi as a media centre seems to be an extremely popular option, it isn't the only way in which this versatile little computer can be put to work.

There are dozens of ways in which the Pi can be used to achieve various purposes and to compete many different tasks, from using it as a NAS to running a web server or even a carputer.

Across the World Wide Web you can find many examples of ways in which the Raspberry Pi can be used. We've collected the most fascinating and achievable in this section of the guide for you to consider, and to appreciate the magnificence of this tiny home computer.

Note that these projects may involve additional equipment and expense.

8.1 Raspberry Pi + Kindle – Portable Computer!

One of the most remarkable hacks for a Raspberry Pi is to couple it up to a Kindle e-reader, using the latter as an e-ink display for the former.

The connection is via a USB to microUSB cable, and requires that you jailbreak the Kindle, install a terminal emulator and a tool called UsbNetwork. Once the Kindle has been unlocked and the necessary utilities installed you will be on the way to using the e-reader as a display for your Pi. Note that this can only be done with the Kindle models that are equipped with an integrated keyboard. Full steps for building a KindleBerry Pi can be found at http://www.ponnuki.net/2012/09/kindleberry-pi/

8.2 Turn Your Raspberry Pi into a NAS Box

We've already seen how the Raspberry Pi can be configured as a media centre. One great way to serve media files to your Raspbmc device is with a NAS box – another easy to setup project (assuming you have a second Raspberry Pi).

Although not suitable for streaming HD videos (due to the use of the Samba server software), a Raspberry Pi NAS box can be set up as a low-power NAS.

In order to complete this project you will need:

  • *Raspberry Pi (Model B)*

- *An SD card configured with the bootable OS*

- *A USB connected hard disk drive*

- *Ethernet cable for connection to your home network*

You will also need to configure the Samba server on your Raspberry Pi (running one of the Debian distros) and the Samba client on your Windows, Linux, Mac or Android device.

Full details on using your Raspberry Pi as a NAS box can be found at http://elinux.org/R-Pi_NAS.

8.3 Kit(t) Your Car with a Raspberry Pi Carputer

End your TV nostalgia dreams of being David Hasselhoff driving a black Trans-am in Knight Rider – with a Raspberry Pi you can set up your own carputer (although it may not be too hot on conversation).

Building a Raspberry Pi carputer is a bit of a tricky one, although it has been achieved by several users. The key component is a touchscreen display, enabling you to interact with the chosen software (typically Raspbmc as it includes a live weather service) but you'll also need to deal with powering both devices, mounting the display and potentially incorporating a 3G widget for media streaming.

"Pursuit mode" not included, sadly.

8.4 Gaming Machine

Enthusiasts of the arcade gaming emulation platform MAME have ported the software to run on a Raspberry Pi, enabling games designed for cabinet machines to be played.

For the full experience, of course, you should be aiming to construct a cabinet to accompany your Raspberry Pi, monitor, mirror and controller, although you might well skip on the coin-operated aspect of the games machine!

The best approach to building a MAME machine is to run the Raspberry Pi with a slim operating system. This is where Moebius, mentioned in 4.2 Other Distros, comes in handy. For full details, you'll find a mammoth guide to setting up your Pi as a MAME at http://ipggi.wordpress.com/2012/11/26/mame-arcade-game-fun-with-a-raspberry-pi/.

You also may be surprised to learn that the Raspberry Pi makes a remarkably compact and reasonably capable gaming system.

While you won't be playing Call of Duty: Modern Warfare or The Sims 3 on it, you will nevertheless have the power to run a range of retro titles up to around the year 2000, thanks to emulators for many different consoles and computers since the 1970s.

You shouldn't be surprised to learn that there are several games that have been ported from other platforms in order to run on Raspberry Pi.

8.5 Internet Radio

Rather than using your Raspberry Pi as an all-in-one media centre, you might prefer to limit its abilities to playing back music, streamed from the Internet.

There are different approaches to this as a Raspberry Pi Internet radio can be setup without a GUI. In most cases this is preferable (for obvious reasons of space), and the software used can be accessed via SSH.

This Instructable explains how you might do this using just Pandora radio, while you'll find an alternative method courtesy of Bob Rathbone.

8.6 Security System

Do you want to know what is going on in a particular room of your house or outside your property? If so, you can use your Raspberry Pi as a security system, using webcams to observe and a network connection to view from another computer or even from an entirely different location.

There are several varying descriptions on how to achieve this available on the web, but the most important aspects

are to use webcams that have Linux drivers and to use either powered USB cables or a powered USB hub in order to run the cameras. This project is heavy on USB, and as the Ethernet port on the Raspberry Pi is also part of the onboard USB, you can see where there might be some drain on available power.

8.7 Babycam Server

Working to a similar principle (but with added microphones) you can also use your Raspberry Pi to manage a baby-cam server, enabling you to observe and listen to activity coming from your little ones.

Depending on which approach you use, however, this can be a tough nut to crack, due to the problems with compression, the results of night photography and the delay (up to 10 seconds for the image to be captured, compressed and routed to your viewing device).

8.8 Home Automation Server

If you've ever seen a sci-fi film in which the heating, lighting, security and entertainment in a home are all controlled from the same remote device and thought "I want some of that!" then this is the Raspberry Pi project for you.

It is also – if you're coming to the concept fresh – by far the most expensive, as it involves introducing new hardware around your home, enabling you to interact fully through a remote (typically a smartphone) via your Raspberry Pi.

Some good further reading for this project:

- Introduction to Home Automation with Raspberry Pi and Fhem

- Smartenit HomAidPi

- Home Genie

8.9 Test or Live Web Server

Hosting a website can prove expensive, particularly if all you need to share with the web is a single "about" page that perhaps links to other online locations. Paying several dollars a month for this is bad economics, so you might consider taking advantage of your Raspberry Pi to host your online presence.

Thanks to LAMP and SSH this is made possible, even enabling you to run a database-driven website!

PenguinTutor explains how you can setup your Raspberry Pi as your own personal web server, for personal use or for sharing with the web. Note that for the latter you will require a static IP address.

8.10 Wireless Access Point

Finally, you can use your Raspberry Pi as a Wireless Access Point, extending the range of your router. This can have a range of benefits, all of which can be implemented using Pi-Point. You'll find full details, documentation and a custom Raspbian image at http://www.pi-point.co.uk/.

With your Raspberry Pi setup as a Wireless Access Point, the device can be used both as a wireless extender and as a secondary router for offering free wireless access to the surrounding area. This in turn will help you to learn more about wireless networking and security.

9. Raspberry Pi: A Versatile Mini Computer

So you've got your cables, your SD card, your distro of choice and you've been using your Raspberry Pi as a mini computer, perhaps housed in a small case.

There's more that you can do, however. The Raspberry Pi is graced with a very useful pair of pin-based connectors, allowing for the addition of further functions and components. Thanks to breakout boards you can turn your Pi into a programmable Arduino-esque device, completely spinning the concept of this little computer on its head.

Beyond breakout boards you will find even more fascinating tools and components that can be added to a Raspberry Pi.

9.1 Breakout Boards
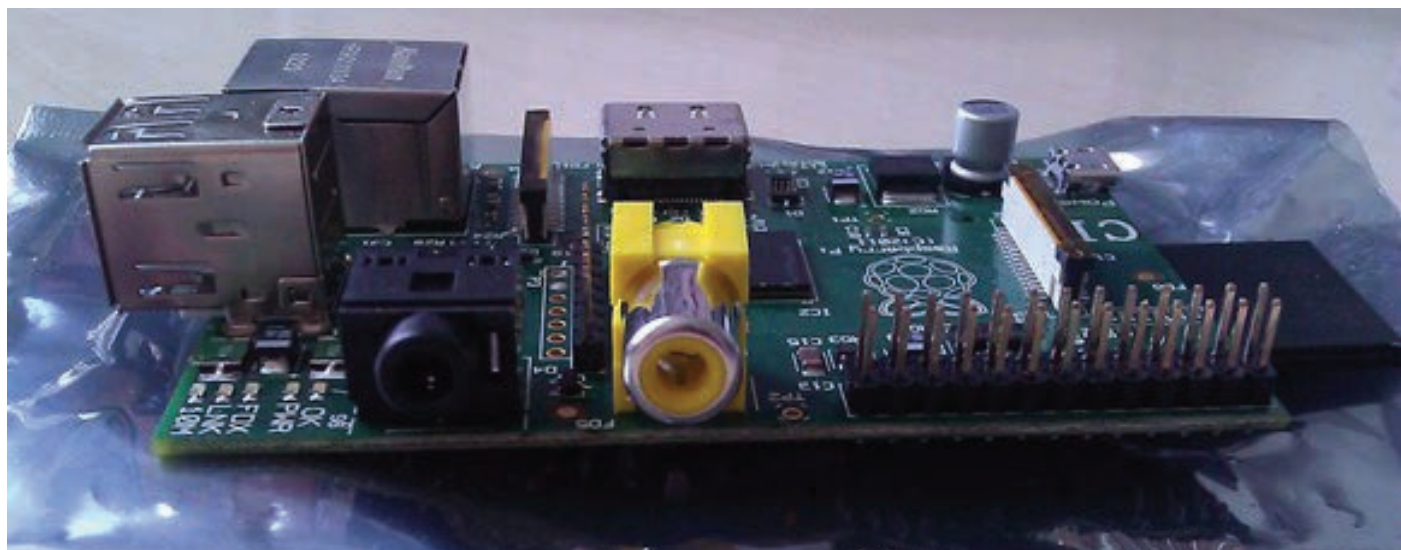
You can take your Raspberry Pi to the next level by taking advantage of a breakout board. Using the GPIO, I2C and SPI pins, these boards come in pre-assembled or kit form, enabling you to extend the functionality of your device. The idea is that you are able to build upon the hardware of the Raspberry Pi by adding more integrated components.

These boards can be used to power other equipment, such as lights, radios or even model train sets.

Breakout boards can be purchased online from sellers such as:

- Hobbytronics

- ModMyPi

- Adafruit

You'll also find sellers on Amazon and eBay offering expansions to the Raspberry Pi.

As you've probably guessed, some understanding of electronics is required before you connect a breakout board.

9.2 Other Non-Essential Components

You'll find through regular use of your Raspberry Pi that many other cables and components can be used, in addition to those outlined in Section 3.

- *Cables – in addition to the cabling discussed earlier, you may want to take advantage of the Raspberry Pi's audio out port and connect the computer to your surround sound system. Alternatively, you might like to output video to a device other than a HDMI monitor – something you can only do with an RCA cable.*

- *Cooling components – if you're planning on a lot of HD decoding on your Raspberry Pi, you will need to consider some form of cooling. While a decent case will provide vent slots above the main CPU, you should perhaps also consider some form of heat sink. There are several available, from the small, traditional radiators found in desktop PCs to the more unique, "wavy metal" variety.*

- *Wi-Fi – the Raspberry Pi will support a large number of USB wireless dongles. You'll need to do some research to find the full list of compatible devices, but you shouldn't need to spend too much to find one that is both suitable and easy to set up.*

- *A hook-and-loop fastener strip such as Velcro – if you're planning to deploy your Raspberry Pi as a media centre, NAS box or simply as a computer for development (as intended!) you might consider some means of attaching it to your table, back of your TV or atop your hard disk drives. Unlike a desktop computer whose weight dominates over movement from the cables, a Raspberry Pi will often be pushed about, particularly by an Ethernet cable. Using a strip of something like Velcro will put an end to this, fixing the computer in place and avoiding potentially nasty knocks.*

10. The Cream on Your Raspberry Pi

Whether you're planning on setting up a media centre, turning your Raspberry Pi into a NAS box or simply using it for its core purpose to learn programming, it should be extremely clear just how versatile this little box of tricks really is.

[image10.jpg]

Installation is a cinch, software is easy to install, and the entire setup will cost you under $50. That's a pretty good deal, especially when you consider that the more recent 512 MB models were made available without a price increase.

Indeed, it is easy to see why this little box of wonders has shipped 1 million units!

You now know everything you need to get started with your Raspberry Pi – so here are ten tips for successful use.

1. Safely boot your Raspberry Pi computer by ensuring that the SD card is inserted before switching on.

2. Launch the GUI by typing startX from the command line.

3. Access the Raspberry Pi via SSH from a desktop computer using software such as PuTTY.

4. Make sure you have a good case for the RaspPi, one that offers ventilation and protection.

5. Various distros (including Debian and Android) are available for the Raspberry Pi. You could run them all, installing them on separate SD cards in order to gain the most flexibility from your mini-computer.

6. Your Raspberry Pi is particularly suited to running as a media centre thanks to the Raspbmc distro.

7. Originally intended as a device to teach children how to program, a good selection of coding tools are available for the Raspberry Pi.

8. There are many uses for this computer, a hugely flexible piece of equipment. Don't forget, however, that it can also run word-processing software, email clients and web browsers.

9. You can extend the possibilities of the Raspberry Pi by adding breakout boards.

10. Safely shut down your Raspberry Pi by switching to the command line and typing **sudo shutdown** (**sudo shutdown -r** to reset). Remember to remove the power cable when the computer is shutdown.

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