GETTING STARTED WITH RASPBERRY PI

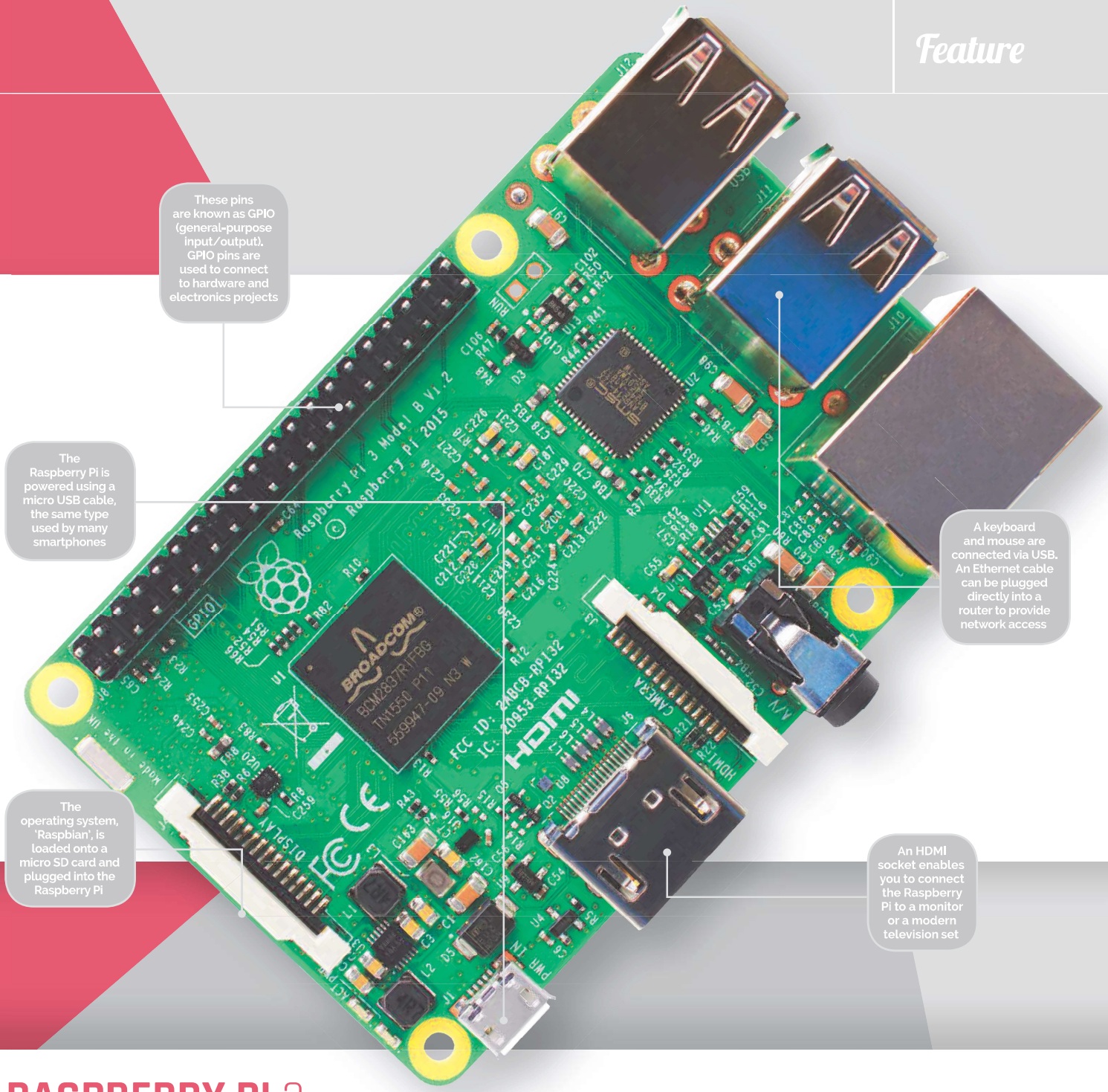
Creating amazing projects is easy with a Raspberry Pi, but first you need to plug it in and set up Raspbian, the default operating system. This guide will get you up and running in no time

The Raspberry Pi is a wonderful microcomputer that brims with potential. With a Raspberry Pi you can build robots, learn to code, and create all kinds of weird and wonderful projects.

Hackers and enthusiasts have turned Raspberry Pi boards into fully automated weather stations, internet-connected beehives, motorised skateboards, and much more. The only limit is your imagination.

But first, you need to start at the beginning. Upon picking up your Raspberry Pi for the first time, you're faced with a small green board of chips and sockets and may have no idea what to do with it. Before you can start building the project of your dreams, you'll need to get the basics sorted: keyboard, mouse, display, and operating system.

Creating projects with a Raspberry Pi is fun once you've mastered the basics. So in this guide, we're going to take you from newbie zero to Raspberry Pi hero. Grab your Raspberry Pi and let's get going.



RASPBERRY PI 3

The Raspberry Pi 3 is the latest model, and the version recommended for most newcomers

SD card

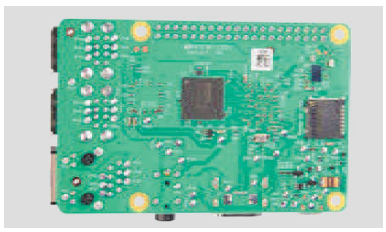
On the underside of the Raspberry Pi 3 board is the SD card slot. You preload the operating system onto a micro SD card and use it to boot up the Raspberry Pi.

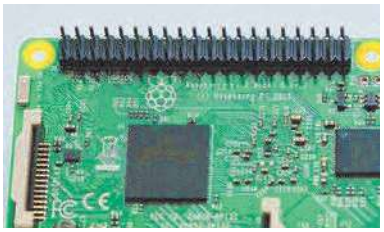
Wireless network

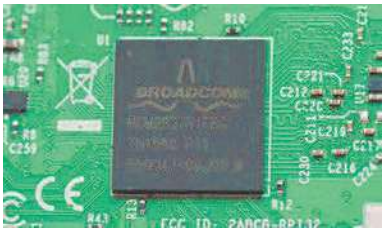
The Pi 3 is the first Raspberry Pi to feature built-in wireless LAN and Bluetooth. This enables you to connect to a wireless router and get online without using a WiFi dongle.

1.2GHz ARM CPU

Featuring the latest 1.2GHz quad-core ARM CPU (central processing unit), the Raspberry Pi 3 is faster than many smartphones, and powerful enough to be used as a desktop computer.







RASPBERRY PI ZERO

Ultra-low-cost, super-tiny, and incredibly powerful, the Pi Zero is the tiniest Raspberry Pi computer

The Pi Zero is an ultra-low-cost and incredibly small microcomputer packed onto a single board. It's roughly a third the size of the Raspberry Pi 3, and has a teenie price tag ($5, or around £4).

For all that, the Pi Zero is packed with enough power to handle demanding computer projects.

Despite its diminutive stature, the Pi Zero is no toy. The Pi Zero is a fully fledged microcomputer with a 1GHz ARM CPU and 512MB RAM. It packs enough technology to run the full version of Raspbian, just the same as the Raspberry Pi 3.

The smaller board is more minimalist than other Raspberry Pi units, which makes it more challenging to set up. But it's a rewarding device that's ideal for creating Internet of Things, wearable, and embedded projects.

To keep the size down, the Pi Zero features a smaller-than-normal mini HDMI socket. You'll almost certainly need a mini HDMI-to-HDMI adapter or cable to connect the Raspberry Pi to a television or monitor.

Alternatively, hackers can hook up an RCA cable directly to the video headers on the board. RCA cables are the red, white, and yellow plugs that you find on older televisions. This feature makes the Pi Zero a great choice for retro gaming enthusiasts.

PI ZERO

Powerful processor

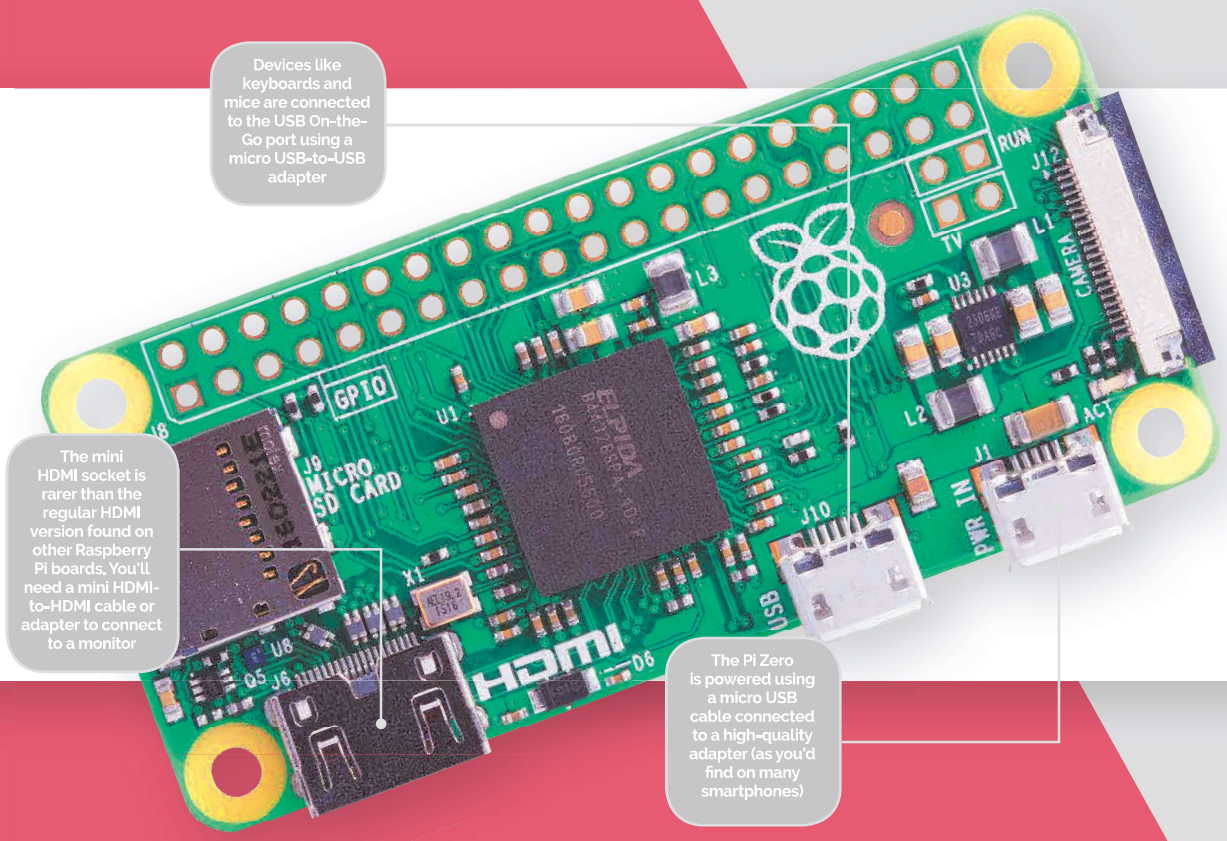
The Pi Zero packs a sizzling 1GHz single-core ARM 11 CPU with 512MB RAM. Despite its diminutive size, it's 40 percent faster than the original Raspberry Pi model.

Tiny form factor

The Pi Zero offers a full computer experience, complete with the Raspbian operating system, and is only a third the size of the original Raspberry Pi.

GPIO to go

The full GPIO header sits along the side of the Pi Zero board. These holes enable makers to attach hardware to the Pi Zero, and you can experiment with electronics projects.



The Pi Zero board uses the same micro USB power input as other Raspberry Pi devices, and you can use an official adapter or salvage a high-quality power supply from a mobile phone (2A output is recommended).

> "Ports are minimal on the Pi Zero, and it sports a single USB port that's smaller than a regular one"

Ports are minimal on the Pi Zero, and it sports a single USB port that's smaller than a regular one. You'll need a micro USB-to-USB adapter to connect your keyboard. You may also want a USB hub to connect a mouse and other devices like a USB camera.

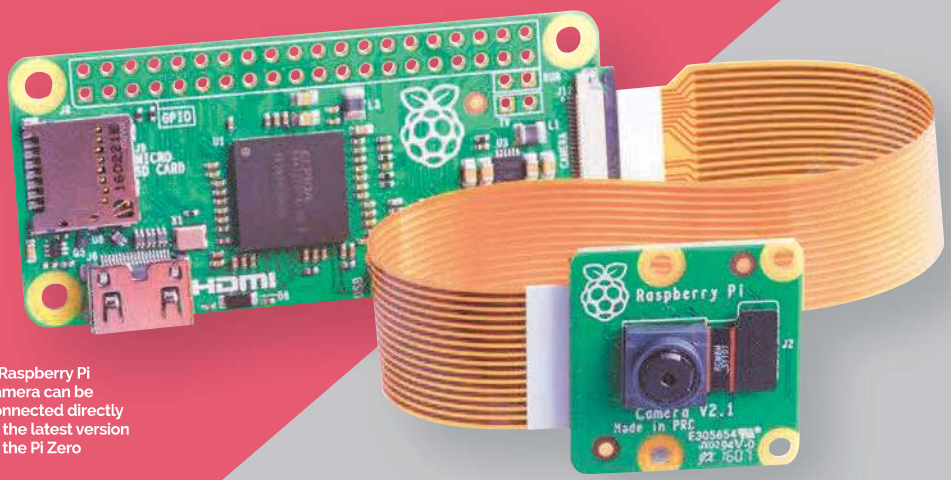
A recent version update, Pi Zero v1.3, has a built-in camera connector. Like the other Raspberry Pi devices, you can connect a Raspberry Pi Camera Module or NoIR Camera Module directly to the Pi Zero. This enables you to turn the Pi Zero into a super low-cost camera for taking photos and recording videos.

Thanks to the low power draw of the Pi Zero, this is ideal for time-lapse photography. You just set it up and let it get on with it.

Hooking a Pi Zero up to the internet requires either a USB-to-Ethernet adapter or, more commonly, a WiFi dongle.

Amazingly, the Pi Zero even has the full 40-pin GPIO header of the other Raspberry Pi models, but you don't get the pins pre-built onto the board. Instead, you need to solder two 20-pin male headers to the GPIO holes.

Setting up a Pi Zero is slightly more tricky than a Raspberry Pi 3, but it's also a lot of fun. The end result is a super-cheap, super-powerful computer that runs a full operating system.



A Raspberry Pi camera can be connected directly to the latest version of the Pi Zero

EQUIPMENT YOU'LL NEED

All the kit you need to get a Raspberry Pi up and running for the first time

You don't require much to get your Raspberry Pi started: a micro SD card from an old camera, a smartphone charger, a recycled HDMI cable, and a keyboard and mouse are all you need.

Most items can be sourced from computer hardware around the house, or begged and borrowed from friends and family. If you're looking for the ultimate in low-cost computing; the Raspberry Pi is it.

You should be able to source, salvage, and scavenge most equipment you need to get a Raspberry Pi up and running. To get the most out of your Raspberry Pi in the long term, though, you should use high-quality components.

A good micro SD card from a named brand will be faster and more reliable. Not all USB power adapters are born equal, either. A reliable branded adapter will provide a steady stream of power, even when you attach multiple devices.

The Raspberry Pi board isn't shy, and it'll work just fine naked, but a good case keeps the board safer and makes it easier to store. There's a huge range of cases available, and many offer unique features such as waterproofing, stackability, or wall mounting.

The official Raspberry Pi case is a slick piece of kit that's perfect for any Pi user. Made of five parts that click together, it enables you to quickly open the case and access the board and GPIO pins.

Any equipment you can't recycle can be picked up from the Raspberry Pi Shop (**magpi.cc/2bnamFF**) or from distributors like Element14 (**element14.com**), Allied Electronics (**alliedelec.com**), and RS Components (**magpi.cc/2bnapBl**).

MICRO SD CARD

The micro SD card acts as the hard drive for your Raspberry Pi. You install the Raspbian operating system onto the card, then all your documents, files, and projects are saved to it as you work.

Raspberry PI fan Jeff Geerling did a community favour by purchasing over a dozen different micro SD cards and benchmarking each one. The results were pretty dramatic, with some cards running up to four times as fast as others. Samsung Evo+ and SanDisk Extreme are two popular brands worth looking out for, and both are fairly cheap. You can read more at **magpi.cc/2bncFs3**

HDMI cable

An HDMI cable is the easiest way to connect your Raspberry Pi to a computer monitor or television. You don't need an expensive one, and most people recycle one from an old games console or DVD player.

USB power

A good 2A or 2.5A power supply provides you with enough power to run a Raspberry Pi with all kinds of peripherals connected. You can buy an official Universal Power Supply (**magpi.cc/2a14pye**).

Keyboard

Any standard USB keyboard can be used to enter commands to your Raspberry Pi. You can use a Bluetooth keyboard with the Raspberry Pi 3, or any other Pi with a Bluetooth dongle attached. A wired keyboard is easier to use when setting up your Raspberry Pi.

Mouse

Any standard mouse will work with the Raspberry Pi, although ones with two buttons (non-Apple mice) work better. Like keyboards, a Bluetooth mouse will work once it's paired, but a wired mouse works as soon as you plug it in.

INSTALLING RASPBIAN

Discover how to use NOOBS to quickly set up the Raspbian operating system on your Raspberry Pi

Before you start using your Raspberry Pi, it needs to have an operating system (OS). This is the software used to start the hardware, and open and close programs.

Many computers use a specific operating system tied to the hardware. You'll probably be used to Windows on a PC and OS X on a Mac computer.

Most Raspberry Pi owners use an open-source operating system called Raspbian, which is based on Linux. The current version is based on a version of Linux called Debian Jessie, hence the name Raspbian (sometimes you'll hear it called 'Raspbian Jessie').

Linux is like Windows and Mac OS X, but more fun because it's open-source, so anybody can view the source code and improve it.

You can install a range of different OSes on a Raspberry Pi, some based on other versions of Linux, others based on Windows, and even completely unique environments like RISC OS.

Raspbian is the official OS and the one most beginners should start with. It's the simplest to install, easiest to use, and most projects and tutorials use Raspbian as their base.

Start with NOOBS

There are two approaches to installing Raspbian and other operating systems. Beginners should start with NOOBS (New Out Of Box Software). More advanced users may copy an image file containing a whole operating system directly to the SD card.

First, you must format your micro SD card to use the Windows FAT 32 format. The easiest way to do this on a Mac or Windows PC is to use a program called SD Card Formatter (**magpi.cc/2bncvkm**).

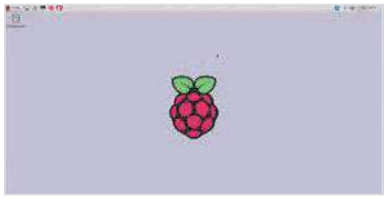
Connect your micro SD card to a Mac or Windows PC, typically using a micro SD-to-SD card adapter or a USB card reader, and use SD Card Formatter to erase the card.

Next, download the NOOBS ZIP file from **magpi.cc/2bnf5XF**. Extract the contents of the file and open the NOOBS folder. Copy the contents across to the root of the SD card. See the 'Setting up NOOBS' steps for more information.

AVAILABLE OSES

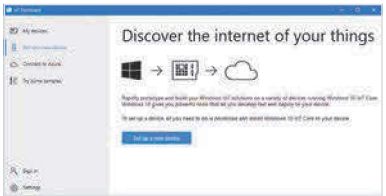
Raspbian

The official operating system is the easiest to use, and the one beginners should start with. It works a lot like other popular operating systems.



Windows 10 IoT Core

Not the full version of Windows, sadly, but Windows 10 IoT Core enables programmers to run Internet of Things and embedded projects.



Ubuntu MATE

Ubuntu is one of the world's most popular Linux operating systems, and Ubuntu MATE is a lightweight version that runs just fine on the Raspberry Pi.

NOOBS automates the process of installing Raspbian. Select the Raspbian option and click on Install to run it

NOOBS automatically copies all the files needed to run Raspbian onto your SD card

With the NOOBS files copied across, remove the micro SD card from your computer and slot it into your Raspberry Pi. Now connect the keyboard, mouse, and HDMI cable. Finally, attach the USB power to boot up the Raspberry Pi.

The Raspberry Pi will boot, displaying the NOOBS installer. By default it only has one option, 'Raspbian [RECOMMENDED]'. Place a tick next to Raspbian and click Install. Click Yes in the Confirm alert to begin installing Raspbian.

Now you just need to wait while the Raspbian file system is extracted. When it's finished, you'll see the Raspbian desktop and the message 'OS(es) Installed Successfully'. Click OK to start using your Raspberry Pi.

Installing image files

Installing an operating system from an image file is a slightly more complex procedure, but one that more advanced (and Pi Zero) users should learn. Image files are copied differently in Windows, compared to Linux and Mac computers.

In both systems, you format the micro SD card to FAT 32 as usual, then you download the operating system as an image file, a large file ending in '.img'. This file is then copied bit by bit as an exact replica to the micro SD card.

On a Windows PC, you will copy the image file using an app called Win32DiskImager (**magpi.cc/2bndEsr**). On Mac and Linux machines, most users copy the file using a command called 'dd' in the terminal.

Full instructions for copying image files for Windows, Mac, and Linux can be found on the Raspberry Pi website (**magpi.cc/1V50j8E**).

A good alternative for Mac owners is a program called Apple Pi Baker (**magpi.cc/2bcD53z**). This program enables you to pick the image file and the SD card, and then handles the copying automatically.

Learning how to copy image files is essential if you want to use operating systems other than Raspbian. Beginners should stick with NOOBS to install Raspbian to start with. It's much easier and is the best operating system for beginners.

OSMC

OSMC (Open Source Media Centre) is an easy way to transform your Raspberry Pi into a video and audio player.

RISC OS

RISC OS is an operating system originally designed by Acorn Computers for ARM-based systems. It's very light and completely different.

SETTING UP NOOBS

Download NOOBS

In a browser, visit **magpi.cc/2bnf5XF**. Click Download ZIP to get all the files. Open your downloads folder and locate the NOOBS file: currently it's 'NOOBS_v1_9_2'. Right-click on a Windows PC and choose Extract All, then Extract. Just double-click the file on a Mac to extract it.

Format SD card

Open SD Card Formatter and you'll see the card in the Drive letter. Change the Volume Label to BOOT so you can identify it later. Now click Option and change Format Type to Full (Erase). Ensure Format Size Adjustment is set to Off and click OK. Click Format, then OK. Click Exit to close SD Card Formatter when it's finished.

Copy NOOBS files

Open the freshly extracted folder so you can view all the files. It should have folders called **defaults**, **os**, and **overlays**, and files including **bootcode.bin** and **recovery**. Select all of the files and drag them onto the BOOT icon in the sidebar. This copies all of the files inside the NOOBS folder to the root of the SD card. It's important to copy the files inside NOOBS, and not the NOOBS folder itself.

USING RASPBIAN

Getting to grips with the Raspberry Pi's official operating system

A Raspberry Pi can run many operating systems (OSes), but Raspbian is the official OS and the one most newcomers will start with.

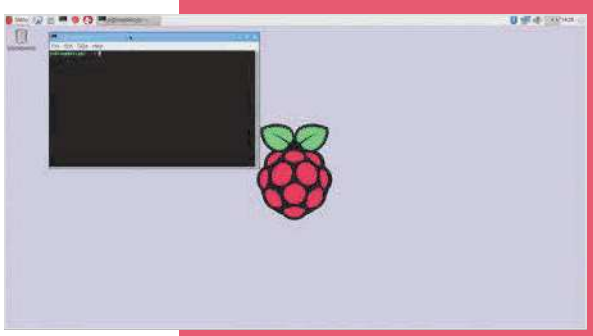
Raspbian is a Linux operating system based on the popular Debian distribution. Fully customised for the Raspberry Pi hardware, it's usually a trouble-free experience using a Raspberry Pi with Raspbian.

One aspect of Linux that will be new to Windows and Mac users is being able to choose from different graphical interfaces. Raspbian includes one called LXDE, which stands for 'Lightweight X11 Desktop Environment'.

This heavily modified version of LXDE enables you to use a Raspberry Pi as you would another computer. You have a Menu button, which offers access to most of the programs and apps installed. Programs open in windows, which you can switch between, minimise, maximise, and close using buttons.

Many users might be wondering why this is anything special. Well, computers didn't always have windows; instead, most users used a command-line interface and entered text commands to start programs.

You'll learn how to use the terminal and control your Raspberry Pi computer using text commands



Terminal velocity

In Raspbian, you'll probably spend some time working under the hood of the desktop in a command-line environment. Next to the Menu button is the terminal, a program that enables you to enter Linux text commands. Learning how Linux works, and how to create programs that run from the command line, is part of the joy of owning a Raspberry Pi. It's a return to classic computing where you need to learn how things actually work.

Raspbian is a great environment for learning to code. Along with easy access to the command line, you get all kinds of programming environments built in: everything from MIT's Scratch to Python and Java. You even get a full working version of Mathematica, a cool maths environment that normally costs £190 to buy, with access to real-world data.

It's possible to buy SD cards pre-formatted with the Raspbian software. This saves you from having to install the operating system

Office worker

It isn't just about programming, though. You can use your Raspberry Pi as a desktop computer, and the operating system comes with LibreOffice built in. This is a full office suite of programs, similar to Microsoft Office. Its programs include Writer (word processing), Calc (spreadsheets),

Impress (presentations), Draw (vector graphics and flowcharts), Base (databases), and Math (formula editing).

Raspbian connects to the internet, and has a built-in web browser called 'Epiphany'. You also get an email client called 'Claws Mail'. Both can be accessed under Menu > Internet.

The Raspberry Pi connects to the internet using Ethernet (a cable that runs from your Raspberry Pi to a modem/router) or WiFi. It's easy to connect to a WiFi network, and we'll look at setting up both WiFi and Bluetooth next.

Settings and software

You can adjust the settings for your Raspberry Pi in two ways: using the desktop interface or a terminal program called Raspi Config.

Choose Menu > Preferences to find a collection of different system settings. Add / Remove Software can be used to find and remove packages from the Raspbian system.

Appearance Settings, Audio Device Settings, Main Menu Editor and Mouse & Keyboard Settings all adjust appearance and interaction with Raspbian. Most of the options are self-explanatory.

The Raspberry Pi Configuration choice provides more in-depth options. Here you can change your password (**raspberry** by default) and the hostname of the Pi on the network (**raspberrypi** by default). You can choose to boot to the desktop or the command-line interface (CLI), and enable and disable various hardware interface options.

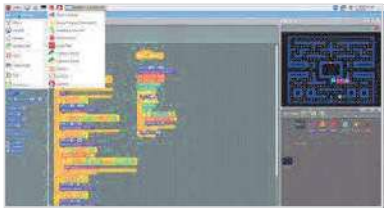
Raspi Config offers even more detailed options. Open a terminal window and then enter `sudo raspi-config`. A blue screen with options in a grey box appears. Use the up and down arrow keys to move between options; press the right and left arrow keys to move into an option (and back to the main menu). More information on these options can be found at **magpi.cc/2bnfuJF**.

The important thing about Raspbian is not to worry about experimenting with different options and settings. Feel free to explore the menus, command line, and configuration settings. You can always reset your micro SD card with NOOBS and start again.

USING THE RASPBIAN INTERFACE

Programming tools

Raspbian comes with a selection of coding tools, found under Menu > Programming. Scratch makes it easy to learn programming concepts, and popular languages like Python and Java are ready to use right out of the box.

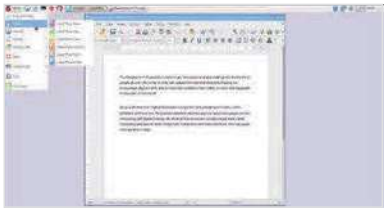


Web software

A web browser called Epiphany is built into Raspbian, along with an email program called Claws Mail. There are links to Raspberry Pi Resources and *The MagPi* under Menu > Internet.

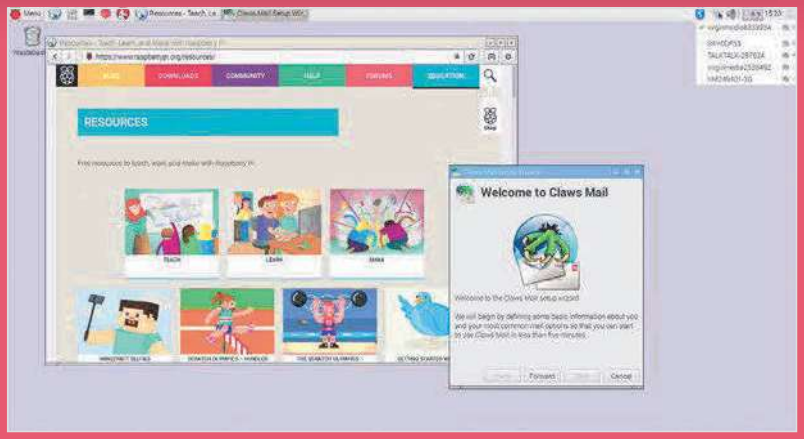
Office suite

Raspbian features powerful LibreOffice programs like Writer and Impress. These are the equivalent of Microsoft Office apps and enable you to create documents on your Raspberry PI.



SETTING UP THE INTERNET

Get online wirelessly and quickly, with this guide to setting up wireless LAN on your Raspberry Pi



A wireless internet connection enables you to get help online and set up apps like Claws Mail

The Raspberry Pi is best when connected to the internet. You can use it to browse the web, play online videos, and send and receive emails. More importantly, you can get the latest updates and install the software packages you need for any project.

To do this, you'll need to get online. With the Raspberry Pi 3 this is easier than ever, because it now has a wireless antenna built into the board.

Other models of Raspberry Pi, including the Pi Zero, require a WiFi dongle connected to a spare USB port.

With wireless added to your Raspberry Pi, it's easy to get online. Boot into the Raspbian desktop and look for the WiFi Networks icon in the Panel (on the top-right of the display).

Click WiFi Networks and you'll see a list of all the local wireless networks. Choose your network and (if you have one) enter your password, also called the 'Pre Shared Key'. The Raspberry Pi connects to the wireless network, enabling you to get online. In this respect it's pretty much like any other computer that connects to WiFi; it will even remember the password for next time.

Once you're online, you can use the Epiphany browser to fetch webpages. Click Web Browser in the Launch Bar.

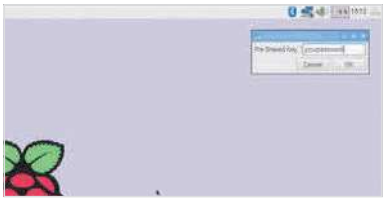
CONNECTING TO A WIRELESS NETWORK

Check for networks

Click on the Wireless Networks icon in the Panel. Raspbian will display a list of all the wireless networks available in your local area. Click on the one that's yours.

Enter your password

Enter your WiFi password in the Pre Shared Key field and click on OK. The network symbol will switch to a wireless symbol and you'll be connected.



Test your connection

Test your internet connection by opening a webpage. Click on Web Browser in the Launch Bar and enter **www.raspberrypi.org** in the URL field. Press **RETURN** to load the page.

SETTING UP BLUETOOTH

Connect wirelessly to nearby devices with Bluetooth technology

Devices connected by Bluetooth work wirelessly with your Raspberry Pi

Bluetooth is another piece of technology that has been added to the Raspberry Pi 3 board. With Bluetooth you can connect wireless devices, such as mice and keyboards, directly to your Raspberry Pi.

As with wireless LAN, if you own an older Raspberry Pi model or a Pi Zero, you'll need to attach a USB dongle to use Bluetooth devices.

With Bluetooth hardware on your Raspberry Pi board, it's easy to connect to a device wirelessly, a process known as 'pairing'.

You can pair wireless gaming controllers, like a PlayStation joypad, or Android smartphones. Many Raspberry Pi projects make use of Bluetooth, enabling the Raspberry Pi to communicate with nearby electronic components and devices.

The easiest way to test out Bluetooth is to set up a wireless mouse or keyboard; both are fairly easy devices to come by.

In some ways, the process is similar to connecting to a WiFi network, but the Bluetooth device you want to connect to must be set to pairing mode first. This is also known as making the device 'discoverable'. Putting a device into pairing mode varies by device; holding down the power button until an LED flashes is fairly commonplace, but check with the instructions for your device.

You then use the Bluetooth icon in the Raspbian desktop Panel to connect to the device: choose Bluetooth > Add Device.

It's possible to put your Raspberry Pi into pairing mode by choosing **Bluetooth > Make Discoverable** from the Panel. Then you can connect to your Raspberry Pi from other Bluetooth devices like mobile phones.

SETTING UP A BLUETOOTH DEVICE

Pairing mode

Start by putting your Bluetooth device in Pairing / Discoverable mode. We're using an Apple wireless keyboard. Hold down the power button until the LED flashes. Click Bluetooth in the Panel and choose Add Device.

Add new device

The Add New Device window opens and will scan for nearby Bluetooth devices. Some will have names, others just identifying numbers (check on the device). Choose a device from the list and click Pair.

Enter code

The Pi now attempts to pair with the Bluetooth device. You'll be asked to enter a code on the keyboard; press the buttons and **RETURN**. You can now start using the Bluetooth device with your Raspberry Pi.